THE BEST SELLING COMPUTER PROJECTS MAGAZINE **OCTOBER 1983** 

DM 5.80 \$2.95

**85p** 



**ELECTRONICS SHOW** 

# AT LAST!



# THE BROADWAY DISC DRIVES FOR THE BBC MICROCOMPUTER

- Dual 800K, Single 400K. 40/80, track switchable.
- Uses new Mitsubishi half height drives.
- Manual, format disc, and leads included.
- Choice of colours oatmeal & chocolate.
- Available NOW direct or from selected dealers.

already in use by many leading colleges and universities.

● Price – 800K £599 + VAT 400K £325 + VAT

# **BROADWAY ELECTRONICS**

The Broadway Bedford. Tel: 0234-213639

#### Available from:-

Windsor Computer Centre, Windsor
Tel: 07535-58077
The Coventry Micro Centre, Coventry
Avon Computer Rentals, Bristol
Camden Computer Systems, Birmingham
3D Computing, Surbiton
3D Computers, Rickmansworth
3D Computers, Ealing
3D Computers, Milton Keynes
Tel: 07535-58077
Tel: 0203-58942
Tel: 021-550600
Tel: 021-771-3636
Tel: 0923-779250
Tel: 0923-779250

Microfactor Computerland, Altrincham

Tel: 061-928-1228

EDITORIAL 01-833-0846

Editor Gary Evans

Editorial Assistant Ann Houghton

Administration Liz Gregory

ADVERTISING 01-833-0531

Manager Claire Fullerton

Deputy Manager Alun Evans

Classified Nik Saha

PRODUCTION 01-833-0846

Design Pat Haylock

Make-up Time Graphics

Publisher Alfred Rolington

**Distribution** EMAP National Publications

**Published By** EMAP Business And Computer Publications

Printed by EMLP Peterborough, England

Subscriptions
Electronics & Computing Monthly, (Subscription Department), Competition House, Farmdon Road, Market Harborough, Leicestershire.

ABC

MEMBER OF THE AUDIT BUREAU OF CIRCULATION

Vol 3 IN THIS ISSUE

# The Electron Evaluated

21

From the mighty BBC micro a tiny Acom has grown. We assess Acom's new offering and report on hardware techniques adopted by the Electron's designers.

# BBC EPROM Programmer

25

The Sideways ROM sockets of the BBC micro are usually used for commercial software. With this programmer, user routines can be developed and blown into EPROM.

#### Sweet Talker

32

Cheetah's Sweet Talker endows the Spectrum report on its capabilities.

#### Single Chip Micro Controller

The Motorola 68705 series of Micro Control units at last provide a unit that is suitable for one-off applications.

# Practical Electronic Techniques 4

The start of a new series that will introduce various aspects of the design and construction of electronic circuits.

#### Oric 6522 VIA 4

A sophisticated input/output port for the Oric based on the versatile 6522 VIA.

#### Book and Software Reviews

Recognising speech is a rather more complex process than its generation. In this article we outline some approaches to recognition and present a couple of circuit ideas and software routines.

#### Hi-Res Computer – The Analogue Board 66

The board takes the *E&CM* computer into the world of control. The design minimises the software overhead involved in using an analogue board by adopting some sophisticated hardware techniques.

# Optimal Programming

70

No. 10

The need for fast and efficient transfer of data is continuing to increase. This feature shows that by careful attention to the way in which data is encoded, significant increases in both these areas can be achieved.

# In Praise Of ZX BASIC

78

ZX BASIC has attracted a fair degree of criticism since its introduction. Mike James reports that despite some disadvantages, Sinclair BASIC has a lot going for it.

# Computer Graphic Techniques

82

Whether your interest is in CAD software or in spicing up a game's graphics this new series will provide plenty of practical ideas for getting the best from any micro's graphic system.

# Spectrum's Effects Box

86

This unit takes the Spectrum's BEEP output as its input and processes it to produce a variety of sophisticated sound effects.

#### Printer Reviews

90

We look at a range of printers from low cost thermal models to sophisticated daisy wheel designs.

## Microdrive Update 93

We take the lid off the Microdrive and report on the hardware of the system.

Comment
Subscriptions
News
New Products
Literature Received 20
Next Month
Reader Services PCB Service
E&CM Binders
Technical Books

See Page 76 for details of our free to enter competition – first prize a trip to Las Vegas.

Electronics & Computing Monthly is normally published on the 13th day of each month

© copyright EMAP Business & Computer Publications Limited 1983. Reasonable care is taken to avoid errors in this magazine however, no liability is accepted for any mistakes which may occur. No material in this publication may be reproduced in any way without the written consent of the publishers. Subscription rates: UK £9.50 incl. post. For overseas rates apply to Subscription Dept., Competition House, Farmdon Road, Market Harborough, Leica.

#### 2SC1945 225 2SC2029 2100 2SC20791 70 2SC20791 80 2SC20791 80 2SC2016 85 2SC2314 85 2SC2314 85 2SC25247 225 2SC25247 205 MPSAGS MPSAGS MPSAGS MPSAGO MPSUGS MP | VK101 | 895 | VK10146AF | 786 | VK1046AF | 786 | VK1046AF | 787 | VK1046AF | 80 | VK1046AF | 2N3704/5 2N3704/5 2N3707/2 2N3772 1 2N3772 1 2N3773 2 2N3819 2N3822/3 2N3822 2N3866 2N3822 2N3866 2N3903/4 2N3905/6 2N4061 2N40661 2N50661 2N5 BF200 A BF224 B BF224 B BF224 B BF224 B BF225 B BF225 B BF225 B BF225 B BF236 7 B BF336 7 BF336 7 BF336 7 BF336 7 BF336 7 BF337 40 BF336 7 BF337 40 TRANSISTORS 35 | 8C213L | 30 | 8C214L | 32 | 8C214L | 32 | 8C214L | 32 | 8C237/8 | 36308 | 37 | 36397 | 36308 | 37 | 36397 | 3637 | 3641 | 36 | 8C547/7 | 36 | 8C734 | 37 | 8C734 | 38 | 8C734 | 39 | 8C734 | 30 | 8C734 | 31 | 8C741 | 32 | 8C741 | 33 | 8C734 | 34 | 8C741 | 35 | 8C730 | 36 | 8C730 | 37 | 8C73 | 38 | 8C73 | 39 | 8D134 | 30 | 8D134 | 31 | 8D144 | 31 | 8D144 | 32 | 8D134 | 33 | 8D158 | 34 | 8D158 | 35 | 8D205/6 | 36 | 8D222 | 37 | 8D378 | 38 | 8D158 | 38 | 8D245 | 39 | 8D136 | 30 | 8D1378 | 31 | 8D245 | 31 | 8D245 | 32 | 8D378 | 33 | 8B514 | 34 | 8D378 | 35 | 8B514 | 36 | 8B514 | 37 | 8B514 | 38 | 8B514 | 39 | 8B514 | 39 | 8B514 | 39 | 8B514 | 39 | 8B515 | 39 | 8B516 | 30 | 8B517 | 30 | 8 35/37 CARDIFF ROAD, WATFORD, HERTS, ENGLAND MAIL ORDER, CALLERS WELCOME ACY22 41 AD142 AD149 AD161 AD162 Tel. Watford (0923) 40588. Telex: 8956095 2SF45 2SK2BB 2SJB3 2SJB3 3N12B 3N12B 3N140 40315 40324/7 40347 40347 40340 40361/2 4040/8 4040/8 4040/4 40467 40468 404594 40603 40603 40671 240671 ALL DEVICES FULLY GUARANTEED. Send Cheque, P.O.s, Cash, Bank Draft with Orders. ACCESS/MASTER CHARGE Accepted. GOVERNMENT & EDUCATIONAL ESTABLISHMENTS OFFICIAL ORDERS WELCOME. P&P add 60p to all Cash Orders. OVERSEAS Orders postage at cost. AIR/SURFACE (TELEPHONE ORDERS BY ACCESS PHONE: 0923 50234). AF118 AF124 26 AF139 AF17B AF186 AF239 BC107 BC107B BC10B BC109B BC109B BC109B BC117/B BC117/B BC137/9 Export orders no VAT. Applicable to U.K. Customers only. Unless stated otherwise, all prices are exclusive of VAT. Please add 15% to the total cost including P&P. We stock thousands more items. It pays to visit us. We are situated behind Watford Footbell Ground. Nearest Underground/SR Station Watford High Streat. Open Monday to Saturday 9.00am to 6.00pm. Ample Free Car Parking space available. BC140 BC142/3 BC147 BC147B BC148 BC14BB TAG END CAPACITORS 64V 2200 139p, 3300 198p, 4700 245p, 50V 2200 110p; 3300 154p; 40V 4700 180p, 25V 2200 90p, 3300 98p, 4000, 4700 98p; 10,000 320p; 15,000 345p; 16V 22,000 360p POLYESTER CAPACITORS: Axial Lead Type 400V 1nf 1n5 2n2 3n3 4n7, 6n8 11p; 10n, 15n, 18n, 22n 12p; 33n, 47n, 68n 18p; 150n 20p; 220n 30p; 330n 42p; 470n 52p; 680n 1uF 68p; 2u2 62p 180V 10nf; 12n, 39n, 100n 11p; 150n, 220n 17p; 330n, 470n 30p; 680n 38p; 1uF 42p; 1u5 46p; 2u2 48p, 4u7 56p; 1000V 1nf 17p; 10nf 30p, 15n 40p; 22n 36p; 33n 42p; 47n, 100n 42p BC14BB BC149 BC149C BC153/4 BC157/B BC159 BC160 BC167A BC16BC BC170 BC171/2 BC173 BC177/B BC177/B SIEMENS pcb Type Miniature pcby apacitors 2019 Apac RF CHOKES Miniature | POLYESTER RADIAL LEAD CAPACITORS 250V | 10n, 15n, 22n, 27n 6p, 33n, 47n, 68n, 10n 7p, 150n, 22n 10p, 330n, 470n 13p, 680n 19p; 1u 23p; 1u5 40p; 2u2 46p; 1u2 46p; PCB type 1uH, 2u2, 4u7, 10u, 22u, 33u, 47u, 100u, 22ou, 330u, 470u 30p 1mH, 1m5, TANTALUM BEAD CAPACITORS 36V 0 1uF, 0 22, 0 33 15p, 0 47, 0 68, 1 0, 1 5 16p, 2 2, 3 3 18p, 4 7, 6 8 22p, 10 28p, 16V 2 2, 3 3 16p, 4 7, 6 8, 10 18p, 15, 36p, 22 30p, 33, 47 40p, 100 75p, 10V 15, 22 26p, 33, 47 35p; 100 56p; 6V 100 42p BC177/B BC179 BC1B1 BC1B2/3 BC1B6/7 BC212 BC212L BC213 2SC1173 2SC1306 2SC1307 2SC1449 2SC1678 2SC1679 2SC1923 2m2, 4 10mH 22mH, 3 43mH 100mH MYLAR FILM CAPACITORS 100V 1nF, 2, 4, 4nF, 10 6p; 15nF, 22n, 30n, 40n, 47n 7p; 56n, 100n, 200n 9p; 50V 470nF 12p SLIDER POTENTIOMETERS 0.25W Log & Lin Values, 60mm travel 5K – 50Cx Single Gang 70p Self Stick gradated Bezel 42p ICL803BCC ICL821:A ICM7205A ICM7207 ICM7215 ICM7216AJ Talaphone Orders by ACCESS Just phona your order through, we do tha rest (Tal: 0923 50234) TLO72CP TL507 45 110 74251 74259 74265 74273 74276 74278 74279 74283 74284 74285 74290 74293 74297 74298 74351 74365 74366 74366 74366 74368 74368 540 350 250 400 365 225 380 325 620 LS156 LS169 LS161 LS161 LS162 7473 7474 7475 7476 7480 7481 7482 7483 7484 7485 7486 7490 7491 300 MC3405 150 180 00 350 75 635 275 820 275 225 140 150 225 210 16 MC3423 MC4016 MF10 CERAMIC CAPACITORS PRESET POTENTIOMETERS 0.1W $50\Omega$ $5M\Omega$ Miniature Vertical & Horizontal 0.25W 1000: 3 3M $\Omega$ horiz larger 0.25W 2000: 4 7M $\Omega$ vert TLO/4CN TLOB1CP TLOB2CP TLOB3CP TLOB4CN TLO91CP UA2240 UA78540 UAA170 UAA180 S541 S640 S641 S645 S668 \$365 \$373 \$374 \$387 \$412 \$470 \$471 \$472 \$474 \$475 \$571 \$573 SERAMIC CAPACITORS Range: 0 5pF to 10nF 4p each 15nF, 22nF, 33nF, 47nF 5p each 100nF/30V 7p; 200nF/6V 8p 100 24 45 75 90 55 120 230 170 180 MF10 MFC6040 MK50398 ML924 MSM5526 NE515 NE529 NE531 NE534 NE543K NE544 NE564 ICM7216AJ ICM7216B ICM7216C ICM7217A ICM7240 ICM7555 ICM7556 ICM7556 ICM3550 LA4031P LA4032 LA4400 LA4422 LC7130 LC7120 LC7137 POLYSTYRENE CAPACITORS: 10pf to 1nF 8p; 1 5nF to 12nF 10p COMPUTER ICS LS670 LS673 LS674 B243 8250 SILVER MICA (Values in pF) RAM 8251 A 8253 SILVER MICA (Values in pF) 2 3 3 4 7 6 8 B 2 10 1 12 15 18, 22 27 33 39 47 50 56 68 75 82, B5 100 120 150 180pf 200 220 250 270 300 330, 360, 390 470 800 800 820 210 each 3300 4700pf 3300 4700pf FOR 2114I 200n 95 440 UPD7002 440 Z80CPU 2.5M 285 Z80ACPU 4M Z80 CTC 250 Z80A CTC 260 Z80B £11 Z80 DART 496 Z80A DARI 698 Z80A DMA 695 Z80 DMA 695 2114L 2 2147 2532 2564 27L08 27L32 395 300 £6 450 550 250 250 295 425 8255 8256AC 225 £35 400 395 £40 £17 410 ULN2003 ULN2004 ULN22B3 BBC 75 75 75 375 330 270 270 195 300 195 375 575 675 360 80 130 130 130 346 300 410 210 200 665 850 74LS 7,492 7,493 7,494 7,495 7,4104 7,4107 7,4109 8257A 8259 8271 8272 8279 MICRO NE556 NE556 NE556 NE560 NE561 NE562B NE562B NE566 NE5566 NE570 NE570 NE570 NE570 NE570 NE5534 OM335 S566B SAB32209 SAB32219 SAB32219 SAB32219 SAB32219 SAB32219 SAB32219 SAB32219 SAB32217 SAB32 45 140 4816AP UPC575 UPC1025H UPC1182 UPC1156 UPC1366 XR2206 XR2207 XR2211 XR2216 XR2266 XN414 ZN419E ZN428E ZN428E ZN428E ZN426E ZN427 27L32 2708 2716 2732 2764 2712B-250 27128-400 3242 4027 100ns 325 398 410 120 155 140 400 1 45 105 425 425 325 425 350 350 350 350 350 350 420 480 MINIATURE TRIMMERS Capacitors 2 6pf., 2 10pf. 22p, 2 25pf., 5 60pf. 30p 10 BBpF 36p 8282 8283 8284 8285 LC7137 LF347 LF351 f2 Z80 PIO Z80 A PIO ZBO A SIO 260 275 980 £25 £20 590 190 100 90 325 400 MOS 270 LF353 LF355 LF356 LF357 LF398 74C244 195 74C245 195 74C373 240 74C374 245 74C922 400 74C923 500 RESISTORS Carbon Film Hi Stab. miniature 0.25W RANGE 2112 4M7 Val 242 4M7 1 99 242 33p 0.5W 2112 4M7 E12 3p 1W 2112 4M7 E12 6p 4027 4116-150 4116-200 4118 250 4164-200 4334-3=C 4532-3 5% 100 + 1p 1p 4p LM301 A LM301 A LM307 LM308T LM318N LM319 LM318N LM319 LM342 LM3342 LM3352 LM348 LM349 LM35B LM348 LM349 LM35B LM377 LM377 LM373 LM381 N LM382 LM381 N LM382 LM383 LM384 LM384 LM384 LM384 LM384 LM384 LM384 LM387 LM384 LINEAR IC. 1% Metal Film E24 7p 5p 100+ price applies to Resistors of each type not 4B16 5101-450 6116-150 200 220 340 74L00 68 74L04 85 74L30 50 74L47 380 74L75 145 74L85 349 74L121 165 74L123 325 74C923 500 555CMOS 702 80 75 ZN427 ZN42BE ZN429E ZN459 ZN1034E ZN1040E ZNA234E 550 490 795 450 325 600 550 600 100 6116L 6117 100n 709C 8 pin 6117 100n 6167-6 6502A 6502CPU 6503 6504 250 6504 250 6520PIA 6522 6530 6532 6532 6545 6551 710 741 8 pin 747 C 14 pin 748 C B pin 753 8 pin 8110 9400 C J LS253 LS257 LS258 LS259 LS260 LS261 LS266 LS273 LS275 LS279 LS280 LS283 LS290 LS292 LS293 LS294 LS295 LS294 LS295 LS294 LS295 LS297 DP8304 DS3691 DS8820 DS8830 DS8831 DS8832 E9365 DIODES BRIDGE 285 £11 570 899 650 220 850 160 520 630 220 890 375 £12 650 £4 110 250 590 £68 74 S00 74 S1 0 74 S1 1 AA119 AA129 AAY30 BA100 BAX13 BY100 BY126 RECTI-FIERS TTL74 AY 1 1320 225 AY 1 5050 9 AY 1 5051 160 AY 1 6720 215 AY 3 - 1350 360 AY 1 6720 215 AY 3 - 1350 360 AY 5 1350 360 AY 5 1317 4 530 AY 5 1350 380 AY 5 1317 4 530 AY 5 1350 382 CA3011 130 CA3012 175 CA3014 275 CA3018 86 CA3019 80 CA3020 210 CA3028 375 CA3036 275 CA31313 275 CA31313 275 CA31313 275 CA31316 375 CA31316 375 SP8629 TA71120 TA7120 TA7120 TA77204 TA7222 TAA661 A TA7222 TAA661 A TA7222 TAA661 A TA7205 TAA900 TBA6100 TBA6200 TBA6400 TBA6400 TBA6400 TBA6400 TBA6400 TBA6400 TBA6400 TBA6400 TBA6400 TCA200 TCA200 TCA2200 TCA2200 TCA2200 TCA2200 TCA2200 TCA2900 T 299 1 25 1 60 1 75 90 150 190 275 395 159 70 275 330 FIERS 1A 50V 1A 100V 1A 100V 1A 600V 2A 50V 2A 200V 2A 400V 6A 100V 6A 100V 6A 600V 10A 600V 10A 600V 25A 200V 25A 600V 8Y164 VM1B DIL 7400 7401 7402 7403 7404 7405 7406 7407 7408 7410 7411 7412 7413 7416 7417 7422 7423 7425 7426 7427 7428 7432 115 160 90 120 95 100 290 £38 £15 20 25 34 30 40 46 65 83 95 125 215 298 240 395 56 50 6800 6802 6803 6804 6805 6808 6809 E9366 FD1691 F01791 125 F01791 225 F01791 223 F01795 228 F01795 228 F01795 228 F01797 228 75107/B 75110 75114/5 75121/2 75150 75154 75159 140 325 70 35 325 196 75 50 125 200 200 225 6809 6810 6821 68854 6840 6843 6845 6847 125 125 75159 125 751882/3 99 75188/9 95 75322 140 753224 360 75365 150 75450 86 75451/2 52 754544 77 75491/2 65 OABI LM733 LM145B LM1871 LM2917 LM3302 LM3900 LM3911 LM3914 LM3915 LM3915 290 190 80 95 80 200 350 775 145 350 220 175 120 290 499 115 350 350 350 LS300 LS302 LS320 LS323 LS324 LS325 LS326 LS327 6847 6859 6850 6852 6854 A202 N914 ZENERS 5 6 6 7 4 15 16 17 19 9 40 65 74174 74175 74176 74177 74178 74179 74180 74181 74184 74184 74186 74188 74190 LS7220 LS7220 MS1513L M51515L M51515L M706 B1 M823712 M823756 MC1204 MC1301 MC1304P MC14516 MC14516 MC14546 MC1495 MC1495 MC1495 MC1495 MC1495 MC1495 MC1496 MC3400 280 230 320 475 Range: 2V7 to 39V 400mW 8p each Range: 3V3 to 33V 1.3W 15p each 6B75 68000 LS347 LS348 LS352 LS353 LS356 1N4006 1N414B 1N5401 1N5404 1N5406 1N540B 1S44 1S921 8035 5A 40V 5A 400V 5A 630V BA 300V BA 300V 12A 100V 12A 800V 12A 800V BT106 BT116 C106D TIC44 TIC45 TIC47 2N5062 2N5064 2N4444 125 220 440 250 79 98 260 150 250 695 300 694 350 70 225 290 90 90 120 65 75 LS109 LS112 LS113 LS114 LS122 LS123 LS124 LS125 LS132 LS133 LS135 LS136 LS138 LS138 LS147 LS147 LS147 LS145 LS154 LS154 LS155 LS155 32 40 48 60 90 78 95 188 150 180 38 24 29 35 32 38 130 B0B0 A B0B5 A 8088 8118-1 B123 B155 B156 81LS95 81LS96 81LS97 B1LS98 B202 250 350 £18 225 125 350 350 80 80 85 £25 7433 7437 743B 7440 7441 7442 7443 7444 7445 7446 7447 200 375 165 90 40 95 160 200 175 255 690 975 99 248 54 56 69 115 78 82 135 103 105 220 220 296 120 325 198 495 330 TDA2002 LS373 LS374 LS375 LS377 LS378 LS379 LS384 LS385 LS390 IS393 LS395 LS395 LS467 TDA2004 TDA2006 TDA2006 TDA2004 TDA2020 TDA2030 TDB0701 TDB0791 TL170 FL061CP FL062CP TL064CN TL071CP 495 320 295 420 420 50 40 60 98 24 S241 S244 S251 S257 S258 S260 S262 S287 S288 S289 B212 B214 B216 3224 B225 B226 8228 100 425 100 110 £11 TMS4532-3 350 TMS4500 £14 TMS5100 600 TMS9927 £14 TMS9928 £20 TMS9929 £20 TMS9995 £12 7447 7448 7450 7451 7453 7454 7460 7470 A3162E CA3162E CA3189 HA1336 HA13BB ICL7106 ICL7107 ICL7611 ICL7660 12A 800V 16A 100V 16A 400V 16A 800V 25V 500V 25A 800V T2B00D VARICAPS

#### MICROCOMPUTER Model £399 incl. VAT (carr. £7)

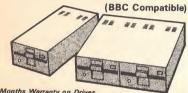
UPGRADE KITS. Upgrade your Model A to Model B with our upgrade Kits and save yourself £ s s s . .

•	BBC1 16K Memory (8x4816AP-3 100nS)	£16.00
•	BBC 2 printer User I/O Port	£6.98
•	BBC 3 Disk Interface Kit (Our 16K DFS)	£85.00
•	BBC 4 Analogue I/O Kit	£6.45
•	BBC 5 Serial I/O Kit	£6.70
•	BBC 6 Expansion Bus Kit	£6.10
•	Printer Cable Ready made 36"	£12.00
•	Complete Upgrade Kit Mod. A to Mod. B	£43.00
•	BBC Joysticks per pair	£11.95

Complete range of Connectors, Cables, Quality Software, Accessories, Books, etc. for BBC available.

Send SAE for detail list.

#### DISC DRIVES 'TEAC'



12 Months Warranty on Drives

•	CS50A - Single Case with PSU, 40 track, 51/4" S/S100K	£170
•	CD50A - Twin Cased with PSU, 40 track, 51/4" S/S200 K	£330
•	CS50E - Single Cased with PSU, 80 track, 51/4"	S/S
	200K	£245
•	CD50E-Twin Cased with PSU, 80 track, 51/4" S/S400K	£475
	CS50F - Single Cased with PSU, 80 track, 51/4"	D/S
	400K	£290
•	CD50F-Twin Cased with PSU, 80 track, 51/4" D/S800K	£575
•	Drive Cable for BBC Single £8, Double	£12
•	MITSUBISHI DISC DRIVES: Uncased, Double Density, D	ouble
	Track, 51/4" Slim line, ONE MEGA-BYTES. Track Density 9	6TPL
	Track to Track Access time 3mSec ONLY	£220
	10 Verbatim Diskettes 5¼" S.S.S.D. (5 yrs. warranty)	£20
•	10 Verbatim diskettes 51/4" D.S.D.D. (5 yrs. warranty)	£30
•	10 Verbatim Diskettes 8" S.S.D.D. (5 yrs. warranty)	£28
	( , , , , , ,	

N.B. Carriage on most of the above items is extra

SEIKOSHA GP100A **BBC PRINTER** 

10" Tractor Feed, 80 columns, 30 CPS, Normal & Double width Characters, Dot res graphics. Parallel Interface standard. ..... ONLY £175 (£7 carr.)

- SEIKOSHA GP250X 10" Tractor Feed, 80 col. 50 CPS, normal & double width & height characters, RS232 & Centronics Interfaces standard ..... £235 (£7 carr.)
- Printer Cable for BBC to SEIKOSHA .... £11

#### NEC PC8023BE-C

100 CPS, Bi-directional, logic seeking, 80 columns, 7 x 9 Dot matrix, superscript & subscript, hi-res block graphics, underlining, true decenders, Tractor Friction feed, Reverse linefeed, 2K Buffer, proportional spacing, attractively finished

£320 (£7 carr.)

Interface Cable for BBC Micro ..... £12

#### LISTING PAPER

8½" & 9½" Fanfold paper plain or ruled (1000 sheets)
£7 (150p carr.) 15" fanfold paper (1000 sheets) £9 (150p carr.) Teleprinter Roll (econo paper) £3 (150p carr.)

4000	10	4076	50	4543	80		PCB Plu		Femal	
4001	12	4077	15	4544	150		with late	:h	Heade	r Card
4002	12	4078	15	4548	40		Strt. A	ngle	Plug	Edge
4006	50	4081	15	4549	375		Pins	Pins	•	Con.
4007	14	4082	15	4553	245	10 way	90p	99p	85p	120p
4008	32	4085	50	4554	190	16 way		50p	110p	
4009	24	4086	60	4555	35	20 way		66p	125p	195p
		4089	125	4556	35	26 way		00p	150p	240p
4010	24	4093	20	4557	320	34 way		36p		
4011	12	4094	70	4558	120	40 way			169p	320p
4012	16			4559				50p	190p	340p
4013	20	4095	95		395	50 way	235p 2	70p	200p	395p
4014	46	4096	70	4560	160	60 way	_		230p	495p
4015	40	4097	275	4561	104					
4016	20	4098	75	4562	495	EURO	CONN	ECT	ORS	
4017	32	4099	110	4566	165	ł	Camata			Plug
4018	45	4160	95	4568	250	Gold Flash	ed Strt.	Angle	Strt.	Angle
4019	25	4161	99	4569	175	Contacts	Pins	Pins	Pins	Pins
4020	42	4162	99	4572	30	DIN41617				
4021	40	4163	99	4580	460	31way	170	)		175
4022	40	4174	99	4581	250	DIN41612				
4023	13	4175	105	4582	99	2 × 32 A +		320	220p	285
		4194	105	4583	99	DIN41612			- acop	200
4024	32	4408	790	4584	48	2×32 A+		340	240p	275
4025	15	4409	790	4585	70	DIN41612		3401	Zaoh	2131
4026	80	4410	725	4597	330		3 × 32 360 p	385	240p	350 p
4027	20			4597	330	A+B+C	3001	2021	240p	2301
4028	39	4411	675	4500	200					
4029	45	4412	775	4599	290	DIL PLUG				
4030	15	4415	480	40085	90	(Header)				
4031	125	4419	280	40097	45		der IDC	1		
4032	80	4422	770	40098	193	14pin 40				
4033	125	4435	850	40100	215			RIB	BON C	
4034	140	4440	999	40101	130	16pin 49			price pe	
4035	45	4450	350	40102	140	24pin 88			Grey	Color
4036	275	4451	350	40103	175	28pin 144	0p —	10 v	/ay 15	28 p
4037	115	4490	350	40104	95	40pin 250	p 255p	16 v	/ay 25	0 40 p
4038	110	4500	675	40105	110			20 v		50p
4039	280	4501	28	40106	35	ZIF DIL			/ay 40	
4040	40	4502	60	40107	60	SOCKET	S		/ay 60	
4041	40			40108	450	24 pin	575o		vay 70	
4042		4503	40	40109	100		750p		vav100	
	40	4504	75	40110	225	40 pin	975p		vay120g	
4043	40	4505	185	40114	240		0.00	044	vay 1201	, 100
4044	40	4506	35	40161	194					
4045	105	4507	35	40163	65			-		
4046	46	4508	130							
4047	40	4510	46	40174	65	D' COI	NECTO	DRS	Minia	ture
4048	40	4511	45		75					
4049	25	4512	45	40181	220		9	15	25	37
4050	25	4513	199	40182	90	MALE	·way	way	way	way
4051	45	4514	115	40192	90	Solder lugs			160p 2	
4052	60	4515	115	<b>→</b> ∪193	95	Angle pins			250p 3	
4053	50	4516	55	40194	90	PCB pins	120p	1300	10Ep 3	305p
4054	85	4517	275	40195	72	FEMALE	1200	1300	195p 2	caab
4055	85	4518	40	40244	195		105-	160.	200-	225
4056	85	4518	30	40245	195	Solder lugs			200p 3	
4057	1915	4519		40257	195	Angle pins			290p 4	
4057			50	40373	240	PCB pins			240p 4	120p
	435	4521	110	40374	245	COVERS	80p	75p	75p	90p
4060	45	4522	125	45106	595	IDC 25 way				
4061	1195	4526	60	45100	990		_ log o	p, c		оор

OPTO LS400C OCP71 ORP12 ORP61 2N5777 BPX25 BPW21 BPX65

CMOS 4000 10 4001 12 4002 12	4076 5 4077 1 4078 1	5 4541 60 4543 5 4544 5 4548 5 4549	140 80 150 40 375	w Si	ECTORS  CB Plugs ith latch trt. Angle ns Pins	Female Header	Female Card- Edge Con.	6MHz Sta	andard .	MODULAT	325p
4006 50 4007 14 4008 32 4009 24 4010 24 4011 12, 4012 16 4013 20	4082 1 4085 8 4086 6 4089 1 4093 4 4094 7	5 4553 60 4554 60 4555	375 245 190 35 35 320 120 395 160		Op 99p Op 150p 5p 166p 5p 200p 5p 236p Op 250p	110p 125p 150p 169p 190p 200p	120p 195p 240p 320p 340p 395p 495p	32.768K 100KHz 200KHz 1MHz 1.28	CRYS 100 235 288 275 392 396	5TALS 4.80MHz 4.433619 5.0MHz 6.0MHz 6.144M 6.5536	200 100 160 140 150 225
4014 46 4015 40 4016 20 4017 32 4018 45 4019 25 4020 42 4021 40 4022 40	4097 27 4098 7 4099 11 4160 9 4161 9 4162 9 4163 9	5 4561 4562 0 4566 5 4568 4569 4569 4572 4580 9 4581	104 495 165 250 175 30 460 250	EURO C Gold Flashed Contacts DIN41617 31way DIN41612	ONNECT Female Socket Strt. Angle Pins Pins 170p 275p 320	TORS t Male f e Strt. s Pins		1.8432 M 2.0MHz 2.4576M 3.12MHz 3.278M 3.5794 4.0MHz 4.80MHz 4.433619	200 225 200 325 160 90 150 200	7.0MHz 7.7328 7.68 MHz 8.0MHz 8.86723 10.0MHz 10.7 MHz 14.31814 48.4 MHz	150 250 200 150 175 175 175 170
4023 13 4024 32 4025 15 4026 80 4027 20	4175 4194 10 4408 79 4409 79 4410 72	5 4583 0 4584 0 4585 5 4597	99 99 48 70 330	2 × 32 A + B DIN41612 2 × 32 A + C DIN41612 3 × 3 A + B + C	270p 340	р 240р	275 p 350 p		PHEN		

RIBBON CABLE price per foot Grey Color 10way 15p 28p 16way 25p 40p 20way 30p 50p 24way 40p 65p 34way 60p 85p 40way 70p 90p 50way100p 135p 64way120p 160p

25 way 'D' CONNECTOR (RS232)

25 way 'D' CONNECTOR (R Jumper Lead Cable Assembly 18" long, Single end, Male 18" long, Single end, Female 36" long, Double Ended, M/M 36" long, Double Ended, F/F 36" long, Double Ended, M/F

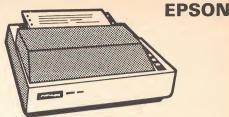
#### AMPHENOL PLUG

IDC Solder 24 way IEEE 475p 450p 36way Centronics 525p 485p

> ORIC 48K Microcomputer

DIL S	OCK Low Prof	ETS Wire Wrap	EDGE CONNECTORS
8pin 14pin 16pin 18pin 20pin 22pin 22pin 24pin 24pin 24pin	8p 10p 10p 16p 20p 22p 25p 28p 30p	25p 35p 42p 52p 60p 65p 70p 80p 99p	2×18 way 180p 2×22 way 199p 2×23 way 190p 2×25 way 225p 2×28 way 210p 2×30 way 245p 2×36 way 295p 2×40 way 315p 2×43 way 335p 2×75 way 550p

| Single ended | 16pp | 20pp | 370p | 480p | 525p | 50pp |



MX100 FT/3

15" Carriage, 136 columns, plus all the facilities of MX80 FT/3 ..... Only £425 (£7 carr.)

#### RX80 £285 (£7 carr.)

100 CPS, 9 x 9 matrix, dot addressable graphics, Condensed & Double width printing, Normal, Italics & Elite Char. Tractor Feed, Bi-directional, logic seeking, Centronics Interface standard.

#### FX80 £385 (£7 carr.)

10" Tractor/Friction feed, 11 x 9 Dot matrix, 160 CPS, 137 columns, bidirectional, logic seeking, proportional spacing, Hi-res bit image, Normal, Italics & Elite Char, Underlining, Subscript & Superscript.

#### MONITORS

MICROVITEC 1431 14" Colour Monitor, RGB Input, (As used in BE	3C
Prog.) Price incl. Connecting Lead 248 (carr. £	7)
ZENITH 12" Green Monitor, Hi-resolution £75 (£7 car	r.)
KAGA RGB 12" Standard Res. Colour £15	9
KAGA RGB 12" Medium Res. Colour£24	ю

#### CASSETTE RECORDER & ACC.

Slim-line portable Computer Cassette recorder with
counter. Mains/Battery operated £24
Cassette Interface LEAD for BBC
DIN Plug to 3 JACK Plugs £2
DIN Plug to DIN + JACK Plug
COMPUTER GRADE CASSETTES C12 40p
STACK-PAK - The unique stackable Twin drawer system for
storing Cassettes. 5 drawers (10 sections) including Ten
C12 Cassettes & Labels £6

#### SPECTRUM FORTH - I/O UNIT

12K of fig-FORTH in ROM. Full RS232 and 24 Bits of I/O for Centronics and Control use. Can be used from BASIC or FORTH. Will work on 16K or 48K Spectrum, Many other features.

#### **ONLY £59**

(Send SAE for full details)

#### SPECIAL OFFER

Upgrade your 16K SPECTRUM to 48K with our 32K Upgrade Kit. Simply plug-in the Chips.

Full instructions supplied.

#### **ONLY £19.50**

#### ★ SEIKOSHA GP-700 ★

The Colour Printer that has broken all price barriers.

A7 colour graphic printer at the price of a standard Dot matrix printer. Its unique 4 hammer method enables text & high res graphics to be drawn in 7 basic colours or 30 shades. 7 x 8 matrix. Up to 106 char. per line at 50 CPS. Variable line as pacing to 1/120". Tractor or Friction feed. Centronix interface standard. feed. Centronix interface standard.

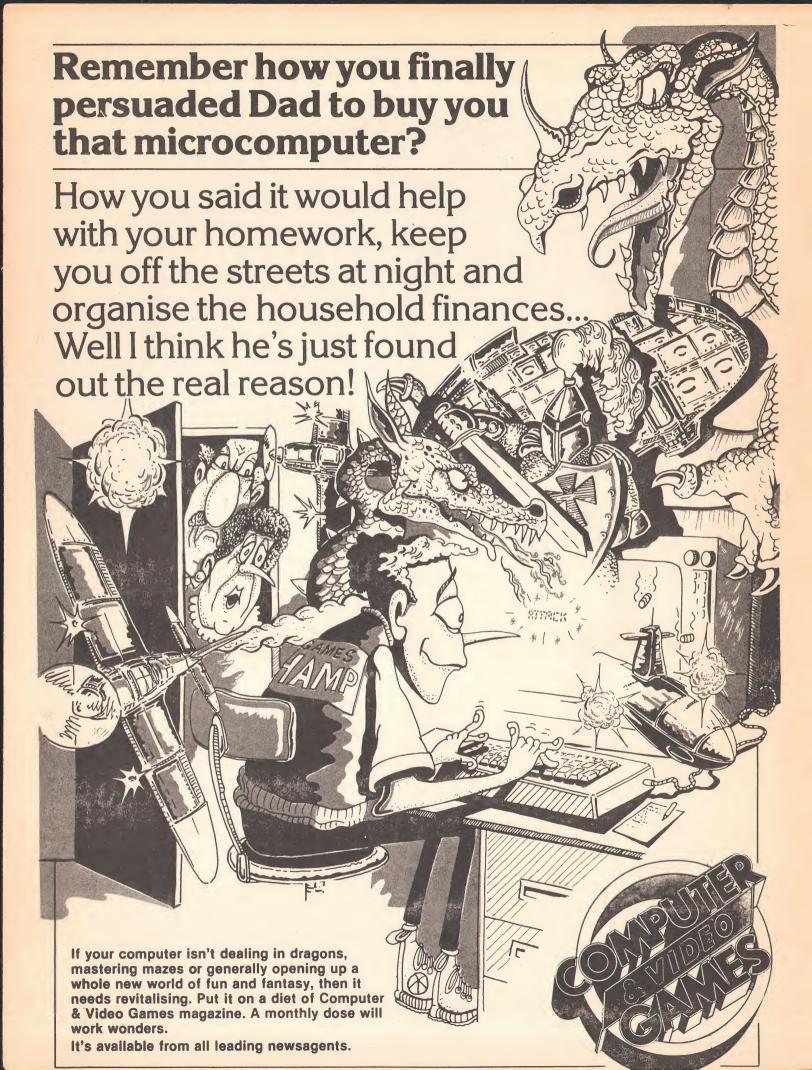
#### Special Introductory Offer: ONLY £399 NFW NEW NEW **BROTHER 8300 DAISEY WHEEL** PRINTER/TYPEWRITER

Provides very high quality type in any six interchangeable styles including Italics, Script and 4 conventional typefaces. It is therefore ideal for business use. It connects directly to a BBC Micro via standard centronics interface or can be used as a stand alone typewriter. As typewriter, it has a built in timing function to measure the operator's speed making it ideal for teaching or invoicing jobs correctly. Friction feed; 11 CPS; 12" maxwidth; 5 different colour ribbons. . . . ONLY 6399

#### FPROM FRASERS

•	Standard EB Erasers. Erases up to 32 EPROMS £33
	GT Eraser. Has a safety switch. Erases up to 32
	EPROMS£35
•	ELECTRONIC TIMER: Solid state, 15-30 min. Connects
	directly to above Erasers. Protect your expensive Chips

from overcooking. Our timer stops you from getting browned off. It pays for itself in no time ..... £15 Spare UV Tube ..... £8



## **UPGRADE YOUR** ZX SPECTRUM NOW!

The CHEETAH 32K Rampack simply plugs into the user port at the rear of your computer and increases the memory instantly to 48K.

- Fully compatible with all accessories via rear edge connector.
- No need to open computer and invalidate guarantee.
- Why send your computer away and wait weeks for upgrade.
- Fully cased, tested and guaranteed.

# Why wait any longer?

ONLY £39.95 inc. VAT and p&p



## Now make your SPECTRUM and ZX81 Talk!

The CHEETAH "Sweet Talker" just plugs into the back of the computer using the existing power supply. Based on an allophone system you can easily program any word, sentence or phrase. Fully cased, tested, guaranteed and compatible with all accessories via rear edge connector. Complete with demonstration cassette and full instructions. No more lonely nights!

Simply incredible at £34.95

when ordering please quote whether Spectrum or ZX81 owner.

Also available:

16K Rampack for ZX81 ..... £19.75 64K Rampack for ZX81 ..... £44.75

Prices include VAT, Postage and Packing. Delivery normally 14 days. Export orders at no extra cost. Dealer enquiries welcome.

Send cheque/PO now to:-

#### CHEETAH MARKETING LIMITED

Dept. ECM/10, 359 The Strand, London WC2R OHS. Tel: 01 240 7939

32K Rampack also available from larger branches of John Menzies and Book



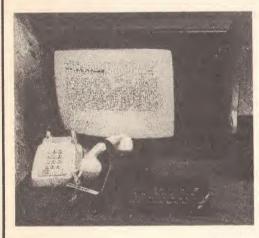




#### **ATTENTION!**

- all ZX81 (16K) and Spectrum (48K) users - get this, the . . .

# Micro-Myte



60

Only

complete, inclusive of VAT, post and packaging in the UK only.



It's the high speed computer phone link you have been waiting for:

Transmits/receives at 1,000 Baud: Three times the speed of most other acoustic modems (including professionals).

**Economic to use:** Communcates data direct between compatible users. Typically 120,000 bits per two minutes of telephone time. (Cheaper than a first class letter.) Also twelve times faster than a telex.

**Simple to operate:** Connects directly to your cassette input/output sockets. Use your home computer like an on line terminal. Link up with your friends by telephone or cable.

The Micro-Myte 60, in its sturdy moulded plastic housing, complements your home computer equipment.

# YOU CAN PRE-RECORD PROGRAM OR SCREEN CONTENTS ON TAPE. YOU CAN TRANSMIT OFF TAPE OVER THE PHONE AND YOU CAN RECEIVE ON TAPE.

I am a ZX81/Spectrum user (specify	)
Please send me Micro-Myte 60 modem(s) at £4 each. I enclose cheque/postal order, payable to Micro-Myte Communications Ltd.	00.8
NameTelephone	
Address	
E	CM10

Micro-Myte Communications Ltd Polo House 27 Prince St. Bristol 1

Telephone (0272) 299373

Callers welcome

# No fuss, no hidden extras, no rental costs

Each kit comprises an acoustic modem, ZX81 and Spectrum software on cassette, connection cable and operating instructions, together with a twelve month guarantee.

#### STOP PRESS!

Micro-Myte 60 will operate with all makes of home computer software available soon

YOU CAN NOW TRANSMIT AND RECEIVE OFF TAPE!

# **EDITORIAL**

After much advance publicity and product reviews in the computing press, Acorn's Electron finally saw the light of day at the Acorn User Exhibition in late August.

The Electron is certainly a good product (see our review starting on page 21) and sales of the machine are almost certain to place a strain on Acorn's production lines for the next few months. Apart from the fact that the Electron is a well made machine selling at a fairly attractive price and its BASIC is by and large compatible with that of the BBC micro, sales of the Electron are bound to be buoyant by virtue of the fact that there will be a wealth of software and is/will soon be available for the machine. Reviews of new computers in E&CM continually point out that any computer with designs on the home computer market must be supported by a sufficient variety of software if it is to have any chance of success.

#### Which Comes First

There is a certain amount of 'chicken and egg' about the situation as it is easy to see that software houses may well be reluctant to expend the time and effort that goes into developing new software unless they can be sure of the success of the target market.

In the Electron's case there are no such problems as, with the exception of programs relying on the BBC's teletext mode, existing BBC software is easily connected to run on the Electron.

The design of the E& CM computer also paid heed to the necessity of providing software support for any computer. The approach adopted was to design a system capable of supporting the FLEX OS. There is a wealth of software written to run on FLEX systems and thus when complete, the E& CM hi-res computer can make use of

'off-the-shelf' software to perform the majority of talks demanded of the system. (Watch out for a new series detailing the renage of FLEX compatible software available in the UK).

The need for software support extends even to development systems. We have a 16 bit microcomputer development system which, when we publish the design, will come complete with a cross-assembler that will allow the board to run software written for a range of 8 bit MPU's. The board won't make full advantage of a 16 bit MPU's speed but it will be capable of running useful software from the word go – surely of more importance than running very fast.

#### Shame About The PR

All and sundry have been singing the praises of the Electron. What won't receive much coverage is the media event that Acorn arranged to launch the machine to the technical press.

I won't bore you with explicit details but will just say that it was one of the worst such events that myself, and various other people with whom I talked, have ever attended.

About the only high point was the Electron cocktail that was served after the launch. For the record, to prepare an Electron cocktail take

1/10th bottle Champagne

1/6th gill Midori (melon liqueur)

1/3rd gill Brandy

1/3rd gill Cointreau

and stir well. Place melon balls in the bottom of glass and for best effect, sugar the rim of the glass.

Gary Evans



# DON'T SUBSCRIBE TO ELECTRONICS AND COMPUTING IF YOU WANT TO ...

spend hours trudging from newsagent to newsagent only to be told they've sold out of your favourite computer magazine — if you're happy to risk missing a vital part of one of our popular series of articles — if you want to miss the first rate projects that we present every month — if you don't want to be protected from any future increases in cover price.

#### ON THE OTHER HAND . . .

You could play safe and subscribe by filling in the coupon below and making sure of your copy each and every month.

SEND TO

# ELECTRONICS & COMPUTING

SUBSCRIPTIONS DEPT COMPETITION HOUSE FARMDON ROAD MARKET HARBOROUGH LEICESTERSHIRE

Please send Electronics & Computing Monthly for the next 12 issues to commence from					
I have enclosed a cheque/Postal order for	£10-70 (UK only) £15.00 (Overseas)				
Name					
Address					
Town					

								_	
4			74LS86	25p ı	74 LS241	70p	74LS644	200p I	
			74 LS90	32p	74 LS242	60p	74 LS668	70p	
	TTLs		74LS92	40p	74 LS243	60p	74 LS669	70p	
	74 SERIES	S	74LS93	32p	74 LS244	70p	74LS670	120p	
	7406	90p	74 LS95 B	50p	74 LS245	140p	74LS682	250p	0
	7407	90p	74 LS96	90p	74 LS251	45p	74 LS684	400p	1
	7416	38p	74 LS107	33p	74 LS253	45p	74 LS687	450p	
	7417	38p	74LS109	33p	74'_S256	200p			- (
	7425	25p	74LS112	33p	74LS257A	45p			
	74121	32p	74LS113	30p	74LS258A	45p	and the same of the	-	
	74128	45p	74 LS114	32p	74LS259	80p	74S SERI		
	74150	120p	74 LS122	60p	74LS260	35p 25p	74 S00	30 p	
	74159	150p	74LS123	60p	74LS266 74LS273	75p	74 S02	30p	6
	74182 74184	50p 120p	74LS124/629 74LS125	36p	74LS273	35p	74S04	30p	
	74185A	120p	74LS125	36p	74 LS280	180p	74805	60p	
			74LS120	42p	74LS283	50p	74508	60p	
	/JL SEF		74LS133	30p	74 LS293	50p	74S10 74S11	40p	
	74 LS00	20p	74LS136	30p	74 LS295	70p	74511	50p 40p	
	74 LS01	20p	74LS138	42p	74 LS298	65p	74530	40p	
	74 LS02	20p	74LS139	42p	74LS299	200p	74532	70p	
	74 LS03	20p	74LS145	75p	74 LS321	240p	74537	60p	
	74 LS04 74 LS05	20p 20p	74LS147	120p	74LS323	200 p	74574	75p	
	74 LS08	20p	74L\$148	120p	74LS324/62	4 150p	74S85 74S86	300p	
	74 LS09	20p	74LS151	50p	74 LS348	140p	74586	900	
	74LS10	20p	74 LS153	50p	74 LS352 74 LS353	70p	745112/3		
	74 LS11	20p	74 LS154	150p 40p	74 LS353	70p 175p	745124	300p	
	74LS12	20p	74LS155	40p	74LS356	180p	745132	60p	
	74LS13	25p	74LS156 74LS157	40p	74LS364	180p	74S133 74S138	110p	
	74LS14	36p	74LS157	35p	74 LS365A	36p	745130	120p	
	74 LS15	20p	74LS160A	50p	74LS367A	36p	74S139 74S151	180p	
	74 LS20	20 p	74LS161A	50p	74LS368A	36p	74S153 74S157	180p	1
	74 LS21	20p	74LS162A	45p	74 LS373	75p	74\$157	250p	
	74 LS22	20p	74LS163A	45p	74 LS374	75p	74S163	300p	1
	74 LS26 74 LS27	20p 20p	74LS164	48p	74LS375	60p	74S174	250p	
	74LS28	20p	74LS165A	60p	74 LS377	90p	74S175 74S194	320p 300p	
	74 LS30	20p	74LS166A	90p	74 LS378	85p	745194	300p	1
	74LS32	25p	74LS170	100p	74 LS379	92p 60p	745196/7	3000	1
	74LS33	20p	74LS173A 74LS174	90p 45p	74 LS390 74 LS393	90p	74\$196/7 74\$200	300p 450p	
	74 LS37	20p	74LS174	45p	74 LS395 A	100p	74S201 74S225	320p	
	74 LS38	20p	74LS175	120p	74LS399	120p		650p	1
	74 LS42	36p	74LS183	120p	74LS540	120p	74S241	300p	1
	74 LS47	60p	74LS190	60p	74 LS608	700 p	74S260 74S261	70p 300p	1
	74LS48	60p	74LS191	60p	74LS610	£19	745261	850p	
	74 LS51	20p 20p	74 LS192	60p	74 LS612	£19	745202	400p	1
	74 LS54 74 LS55	20p	74 LS193	60p	74 LS626	150 p	745374	400p	
	74LS73A	20p	74LS194A	50p	74 LS628	150p	74538	70p	
	74LS74A	30p	74 LS195A	50p	74LS640	200 p	·74S51	75p	1
	74LS75	30p	74 LS196	60p	74 LS640-1		745195	500p	1
ı	74LS76A	27p	74LS221 74LS240	80p 70p	74 LS642-1 74 LS643	200p	745240	250p	1
	74 LS83 A	46p	74 L5240	70p	/4L3043	2000	745244	300p	1
							745373/4		1
	VOL	TAGE RE	GULATORS	1 1					1
ı		FIXED P		14.	ОТ	HER RE	GULATORS	W	
	1A	+ ٧6	-ve		LM309K	140p	78HO5KC	550p	
		7805		45p	LM317K	250p	78MGT2C	140p	1
	5V		40p 7903	45p	LM317T	10Cp	78GUIC	200p	
	12V	7812			LM337T	225p	79GUIC	225p	
	15V	7815		45 p				700p	
	18V	7818		45p	LM323K	450p 30p	79HGKC		1
	24V	7824		45p	LM723		ICL7660	250p	
	EL 4 00 4	7010	E 20- 701 06	=-	TIAGA	400n	TIAGA	300n	

#### **BBC**

5V 100mA 12V 100mA 15V 100mA

#### Model B £347+£7 p&p

78L05 **30p** 79L05 50p 78L12 **30p** 79L12 50p 78L15 **30p** 79L15 50p

650 A to B Upgrade Kit Installation £15
Individual Components and £15 Connectors available

Floppy Disc Interface Kit £95 Installation extra.

#### WORD **PROCESSORS**

TL497

TL494 300p LM305AH **250**p

400p 225p 600p 350p

TL494

78540

78HGKC LM350T

VIEW 16K ROM WORDWISE 8K ROM £34.50 BEEBPEN 8K ROM £32.00

**BEEBCALC Spread Sheet** 

#### **BBC DISC DRIVES**

Single 100K £230

Dual 2 X 400K £699

#### **BBC COMPATIBLE 51/4" DISC DRIVES**

These drives are supplied in BBC matching colour cases.

200K £215\* SINGLE DRIVES CASED 100K £150 400K £265 400K £330 SINGLE DRIVES with PSU 100K £185 200K £260\* 2 x 100K £355 2 x 200K £475\* 2 x 400K £595 DUAL DRIVES with PSU \*These drives are provided with a switch between 40 and 80 tracks. Carriage: £6 per Single drive, £8 per Dual drive. Disc Cable: Single £8

Dual £12. Disk operating system manual for formatting disckette £17.50.

#### SIDEWAYS ROM EXPANSION BOARD

The board provides 8 high quality 28 pin sockets for expanding the computer's sideways ROM capacity by a further 128K (Due to the power consumption of ROMS being approx. 40ma., in our opinion, a maximum of 8 ROMS would not normally overload the BBC Power Supply. The board simply plugs into one of the four ROM sockets. Full fitting instructions supplied. All ROM sockets are with 'turned-pin' gold contacts. The board is fully buffered and dimensioned, ensuring non-interference with on-board components. Fully built and tested board £25 + £2 p&p.

#### TORCH Z-80 PACK

Extend your BBCs capabilities. The twin drives, together with the Z80 card, gives you 64K of memory and includes a database, word processor etc Comes complete with manuals, CP/N Operating System, Demonstration & Utility programs etc. The system is fully compatible with CP/M\* thus allowing the use of professional business software. £825 + £8 p&p.

#### COMPUTER COMPONENTS Z80AS10-0/1/2£9 6522A 550p

300p

350p 250p

600p

500p

450p 950p 300p

140 p 200 p 140 p 225 p

250p 600p

250p 350p

£7.50 350p

£11

MEMORIES

2112-A 2114-2L 2147 4027 3

2114-4L 4116-15 4116-20 4118-3 4118-4 4164-2 4816AP3 5101 5516 6810 745189

74S201 6514

93415 93425

4164-15(T 4416-15 4164-15

93L422 4532-20

74S188 74S287 74S288 74S387

74S262 74S473 74S474 74S475

**EPROMs** 

2708 2716 2564

2516 2532

2732 350 2716 350 2732 350 2732

2732 (300ns) £4

BAUD RATE GENERATORS

6116-3 420p 6116LP-3 550p

ROM & PROM

CPUs:	
1802CE	650p
2650A	£12
6502	350p
6502A	€5
6800	225p
6802 68809	250p £12
6809E	£12
6809	650p
8035	350p
8039	£3
A0808	250p
8085A	350p
INS8060 TMS9980	£11 £20
Z8	£24
Z80	290p
Z80 A	300p
Z80B	£9
8088	£18
TMS9995 TMS1601	£12
IMS1601	1.12

DEVICES £12 280p 310p 550p 650p 100p

280 p 850 p 250 p 390 p 250 p 250 p 9901

UARTS 250p 280p 250p 280p 700p AY 3 1015P AY 3 1013P IM6402 IR1602 COM8017 780ADART LOW PROFILE DIL SOCKETS BY

300 p 300p

MC6847 9365 9366 TMS9928 TMS9929

pin 9p 18 pin 16p 24 pin 24p pin 10p 20 pin 18p 28 pin 26p pin 11p 22 pin 22p 40 pin 30p

WIRE WRAP SOCKETS BY TEXAS 50p 66p 24pin 28pin 8pin 30p 14pin 42p 18pin 100p 130p 20pin 16pin 45p 22 pin 75p 40pin

#### CONNECTOR SYSTEMS

CRYSTALS

200kHz 1 0MMz 1 008MHz 1 8432MHz 2 18432MHz 2 104MHz 2 4570MHz 3 276MHz 3 5795MHz 3 686MHz 4 00MHz 4 194MHz 4 43MHz 5 00MHz 6 144MHz 7 0MHz 7 168MHz 8 86MHz

7 106 MHz 10 70MHz 10 7MHz 12MHz 14 3168MHz 16 00MHz 18 432 MHz 20 000MHz 24 4 MHz 26 690MHz 27 145MHz 38 667MHz 48 0MHz 55 5MHz 116000MHz

116000MHz 350p 24100MHz £2

17.7 KEYBOARD ENCODER

AY 5 2376

740923

FD1771 FD1791 FD1793 FD1795

WD1691 8271

TELETEXT

SAA5020 SAA5030 SAA5041 SAA5050

DECODER ICs

CHARACTER

GENERATOR

RO-3-2513U 750p RO-3-2513L £7

DISC CONTROL

300p

200

700p 420p

600p

£20 £22 £23 £28 £28 550p £26 £22

£6

MODULATORS

6MHz UHF 375p 8MHz UHF 450p

INTERFACE ICS AD558CJ 775p AD561J £20 AD7581 £14

AM25S10 AM26LS2521 £2 AM26LS32 125p DAC80 £24 DM8131 275p

DP8304 DS3691 DS8831 DS8832 DS8833

DS883F

DS8836

F1320

MC1488 81 LS95/96 81 LS97/98 MC3418 MC3446

MC3446 MC3480 MC3486 MC3487 MC4024 MC4044 MM58174 ULN2003A ULN2004A -75107 -75112/14/15 75150P -75182 75365 75451/2

75453/4 75491/2

8T26/28 8T95/96 9602 9637AP ZN425E

ZN426E 8 ZN427E 8 7N428F-8 8835 88LS120 LM1011

CRT

CONTROLLER

TMS9927 TMS9918 6545

MC6845 MC6845SP

55p 120p 120p 950p 250p 850p 500p 300p 325p 325p 850p

150p

72p 72p 65p 120p

90p 220p 160p 350p 350p

650p 450n 200p 350p 480p

900p 650p £12 650p £36 £36

£20 £16

5.068 MHz 210p 32 768kHz 100p

cable with DIP Leader 14pin 16pin 24pin 40pin 145p 165p 240p 380p 210p 230p 345p 540p Double

24" cable with sockets

JUMPER LEADS
24" Ribbon Cable with Headers
Ribbon Cable with Sockets
20 pin 26 pin 34 pin 40 pin
1 end 160p 200p 280p 300p
2 ends 290p 370p 480p 525p

ID CONNECTORS

Edge Conn 120p 195p 240p 320p 340p 390p No. of ways Header Plug Receptacle 90p 8 145p 12 175p 15 200p 16 220p 19 235p 20 20 way 26 way 34 way 40 way 50 way 190p 200p AMPHENOL CONNECTORS

65 50 36 way plug/socket 24 way plug/socket Available in IDC or Solder versi EURO CONNECTORS

Skt. 165 p 170 p DIN 41617 21 way 31 way DIN 4161 Z 2 x 32 way St. Pin 2 x 32 way Ang. Pin 3 x 32 way Ang. Pin 3 x 32 way Ang. Pin 275 p 320 p 300 p 350 p 260p 375p MIN. D CONNECTORS

No. of Ways 80p 105p 160p 150p 210p 250p Solder Angled FEMALE Solder 105 p 160 p 200 p 335 p
Angled 165 p 215 p 290 p 440 p
Hoods 90 p 85 p
IDC 25 way plug 385 p
Socket 450 p

EDGE CONNECTORS 0.1" 0.156

0.1" 0.156" ZIF SOCKETS

— 140p
190p 240p 24 pin £5.75
175p — 28 pin £8.00
225p 220p 40 pin £9.75
190p —
260p —
600p —
600p 2x18 way 2x22 way 2x23 way 2x25 way 2x28 way 1x43 way 2x43 way 1x77 way 5100 Con 600p DIP HEADERS

14pin 16pin 24pin 40pir 40p 50p £1 £2 120p 140p £2 £2.25 Solder type IDC type

RIBBON CABLE (Grey)

Grey/Metre 34 way 160p 40 way 180p 50 way 200p 64 way 280p 10 way **40p** 16 way **60p** 20 way **85p** 26 way 120p

DIL SWITCHES

#### EPROM PROGRAMMER

A fully self-contained Eprom Programmer with its own power supply, able to program 2516, 2716, 2732, 2732A, 2764 and 27128 EPROMS.

Personality selection is simplified by use of a single rotary switch Warning indicator for when programming is in operation. In addition to operating as other standard programmers, it can also read, blank check, program and verify at any location on the EPROM to enable commercially available programmed EPROMs to be customised.

Simple menu driven software supplied on cassette (transferable to disc or EPROM if you prefer) is fully compatible with all versions of operating systems and BASIC.

EPROM Programmer complete with operating software and instructions £79 + £2 p&p.

#### PRODUCTION EPROM PROGRAMMER Type P8000

It will blank check, copy and verify up to 8 Eproms at a time. Eprom types 2716 to 27128 can be selected by a single rotary switch. £695 + £6 carriage.

**EPROMS** 2764-25 £4.50

27128-25 £22.00

#### FULL RANGE OF EPROMS IN STOCK

#### EPROM ERASERS UV 1T Eprom Eraser:

Can handle up to 6 Eproms at a time. Average erasing time 20 mins. Built-in timer and mains indicator. Built-in safety interlock ensures no accidental exposure to harmful UV rays £59 + £2 p&p

ALSO AVAILABLE FROM STOCK FULL RANGE OF TTL'S, CMOS and LINEAR IC'S.
FOR DETAILED PRICE LIST PLEASE SEND S.A.E

## SPECIAL OFFER

2532 350p 2732 2764-25 ..... 450p 27128-25 ..... £25 4164-2 ..... 450p 6116P-150NS .... 350p

#### PRINTERS

NEC PC8023 BE-N	£320
EPSON RX 80	£270
EPSON FX 80	£370
EPSON MX100	£425
Seikosha GP100A	£175
Seikosha GP250	
Carr./printer	8£
Printer leads: Parallel £12 Serial	8£

#### MONITORS

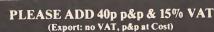
Colour: Microvitec RGB

Type 1431 14" Std.
Type 1451 14" Med. Res. £249 (Leads inc.) Res. £374 (Leads inc.) Res. £499 (Leads inc.)
Res. £319 (Leads inc.)
Std. Res. £220 Type 1441 14" High Type 2031 20" Std. Sanyo colour RGB 14" Std. Res. £399 Kaga colour RGB 12" High Green

Sanyo DM8111CX 12" High Carr. 14" & 20" £8; 12" £6. Res £99 FCM10

ECHNOMATIC LTD

MAIL ORDERS TO: 17 BURNLEY ROAD, LONDON NW10 1ED SHOPS AT: 17 BURNLEY ROAD, LONDON NW10 (Tel: 01-452 1500, 01-450 6597. Telex: 922800) 305 EDGWARE ROAD, LONDON W2



Orders from Government Depts. & Colleges etc. welcome.



Pro Detailed Price List on request ... Stock items are normally by return of post.



# MMABLE 32.95 £1-00pp

#### ABOUT OUR PROGRAMMABLE INTERFACE

Surpassing the outstanding specification of our Interface Module II which still offers the best software support at its price, a Joystick Interface that is compatible with ALL SOFTWARE through its unique hardware programmable design.

The Interface plugs on to the rear connector of your ZX81 or ZX Spectrum.

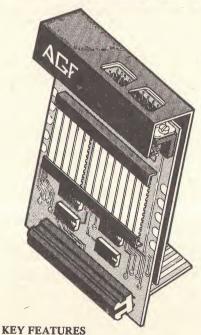
Quick clip-on connections, which are configured from a reference card supplied, allow you to define which of the forty keys are simulated by which action of the Joystick. A pack of ten Quick Reference Programming Cards makes setting for your favourite games even easier. These can be filled in to show at a glance the configuration required and stored in the cassette case of the particular game. When you change to a game using different keys the module is re-programmed in a few seconds. in a few seconds.

As with our Interface Module II the Programmable Interface accepts all standard switch Joysticks that are Atari-compatible, Two sockets are available which are connected together for two player games which use the same keys for both players.

The Interface resides in the keyboard address space and does not affect its operation or interfere with any other add-ons. A rear extension edge connector will accommodate expansion of your system.

The unique AGF key simulation principle makes it extremely easy to incorporate Joystick action in your own programs, All eight directions and fire are read by simple

With every order comes a free demonstration program called 'Video Graffiti' plus a full set of instructions.



- Programmable design gives TOTAL software support.
- Accepts Atari, Competition Pro, Wico, Starfighter, Quick Shot, Le Stick etc.
- Rear extension connector for all other

#### PACKAGE CONTENTS SUPPLIED

- Programmable Interface Module as illustrated, complete with clip-on programming leads.
- ming leads.

  Self adhesive programming chart detailing how to define which key is simulated by UP, DOWN, LEFT, RIGHT, and FIRE. This can be fixed on to the case of your computer or if preferred the protective backing can be left on. The chart is made of a very durable reverse printed plastic and is extremely easy to read.
- One pack of ten Quick Reference Programming Cards for at-a-glance setting to your games requirements. The card allows you to mark the configuration in an easy to read fashion with space to record the software title and company name.
- Video Graffiti demonstration program which is written totally in BASIC to illustrate how all eight directions and fire can be read. This is also a useful high resolution drawing program.
- 12 months guarantee and full written instructions.

CONTROLLERS

FOR USE WITH OUR INTERFACE Module or VIC 20, Commodore 64, Atari VCS, Atari 400, Atari 800

If you require extra Joysticks for our original interface module mark order 'OLD' Joysticks

set of instructions.	* Free demo program and instructions.	ONLY £7.54	inc VAT + P&P					
FROM: MR/	MRS/MISS							
ADDRESS								
*								
1								
SEND C.W.C	D. (NO STAMP NEEDED) TO: A.G.F. HARDWARE, DEPT. EC	M						
	BOGNOR REGIS, WEST SUSSEX, PO22 9BR							
QTY	ITEM	ITEM PRICE	TOTAL					
	PROGRAMMABLE INTERFACE	33.95						
	JOYSTICK(S)	7.54						
	PACK(S) QUICK REFERENCE CARDS	1.00	1					
ONE	VIDEO GRAFFITI	FREE						
	31   ZX SPECTRUM   Please tick	FINAL TOTAL						
DEALER ENQ	DEALER ENQUIRIES WELCOME EXPORT PRICES ON APPLICATION ECM10							

# CITING ADDIT

#### THE MAPLIN TALK-BACK for ZX81 and VIC20

#### Now your computer can talk

- \*Allophone (extended phoneme) system gives unlimited vocabulary.
- ★ Can be used with unexpanded VIC20 or ZX81 does not require large areas of memory.
- ★ In VIC20 version, speech output is direct to TV speaker with no additional amplification
- ★ Allows speech to be easily included in programs.

Complete kits. Order As: LK00A (VIC20 Talk-Back). Price £24.95. LK01B (ZX81 Talk-Back). Price £19.95. Full construction details in Maplin Projects Book 6. Price 70p. Order As XA06G.

#### **SOUNDS GENERATOR** FOR ZX81

3-Programmable tone generators with programmable attenuators turns your ZX81 into a mini-synthesiser.

Noise generator with 3 pitch levels enables the creation of most special effect sounds. Single address access via BASIC with PEEK and POKE. Connects directly to expansion port socket or motherboard.

Complete kit. Order As LW96E. Price £10.95. Full construction details in Maplin Projects Book 5. Order As XA05F. Price 70p.

#### ZX81 INPUT/OUTPUT PORT

Two bi-directional ports for a total of 16 input or 16 output lines.

Includes one buffered output which can interface directly to CMOS.

On board address selection allows for expansion to 6 ports with two boards. Complete kit. Order As LW76H. Price £9.25. Full construction details in Maplin Projects Book 4. Order As XA04E. Price 70p.

#### MODEM

A CCITT standard modem that connects directly to your telephone line via a B.T. approved transformer. Transmits and receives simultaneously on European standard frequencies at 300 baud. May be used to talk to any other 300 baud European standard modem including the Maplin Computer Shopping modem on 0702 552941 and any British Telecom Datel 200/300 Service modem. The modem's computer interface is

RS232 compatible. A complete kit excluding case is available. Order As LW99H. Price £39.95.

Full construction details in Maplin Projects Book 5, Order As XA05F, Price 70p.

#### **KEYBOARD** with **ELECTRONICS for ZX81**

- Full size, full travel keyboard that's simple to add to your ZX81 (no soldering in ZX81).
- Complete with electronics to make "Shift Lock", "Function" and "Graphics 2" single key selections.
- Powered (with adaptor supplied) from ZX81's

own standard power supply.
Full details in Project Book 3 (XA03D). Price 70p Complete kit (excl. case) £21.90. Order As LW72P.

Case £4.95. Order As XG17T. Ready built-in case £29.95.

Order As XG22Y.

#### **ZX81 TV SOUND**

ZX81 sound on your TV set. Video reversing switch for normal or inverse video display. Can be used with the Talk-Back or Sounds Generator kits.

Complete kit. Order As LK02C. Price £19.95. Full construction details in Maplin Projects Book 6. Order As XA06G. Price 70p.

#### **ZX81 EXTENSION BOARD**

Our ZX81 Extendiboard plugs directly into the ZX81 expansion port and will accept a 16K RAM pack and three other plug-in modules simultaneously. Parts are sold separately as follows:

PCB Order As GB08J. Price £2.32. Edge Connectors (4 needed) Order As RK35Q. Price £2.39 each.

Track pins (1 pack needed). Order As FL82D. Price 85p per pack of 50.

#### INTERFACES for MODEM

Interfaces for most popular home computers which do not have RS232 ports will be available shortly. Interfaces for the ZX81 and VIC20 that include a complete Machine Code Communications Program are available. Order AS LK08J (ZX81 Modem Interface Kit). Price £24.95 Order As LK11M (VIC20 Modem Interface Kit) Price £9.45.

Full construction details in Maplin Projects Book 7. Order As XA07H. Price 70p.



Maplin Electronic Supplies Ltd., Mail Order: P.O. Box 3, Rayleigh, Essex SS6 8LR Tel. Southend (0702) 552911 (Sales).

Mostly Mich.

159-161 King St., Hammersmith, W6, Tel. 01-748 0926, 284, London Road, Westcliff-on-Sea, Essex, Tel. (0702) 554000. Lynton Square, Perry Barr, Birmingham. Tel. (021) 356 7292. All prices include VAT & carriage, Please add a 50p handling charge to orders under £5 total value.

#### **NEWS & VIEWS**



#### **Short Form**

Apologies for the rather truncated news section last month but the arrival of the Microdrive on the eve of our press day meant that a number of items had to be dropped at the last moment.

Things are thankfully back to normal this month.

#### Bye Bye Brainwave

As one of the magazines that took an active part in the preparations for Brainwave '83, it is with regret that we have to announce that the show has been cancelled.

The reasons for the show's cancellation are many and varied and the columns of *E&CM* are not the place to indulge in a post mortem of the exhibition that never was. We would however like to thank those at EMAP who worked enthusiastically on the Brainwave concept over the past few months and in particular to Richard Jansz. Richard has now moved onto the staff of *E&CM* and has thankfully recovered from his post-Brainwave blues.

Just as we were closing for press news of another aborted exhibition reached us. The Electronic Hobbies Fair which was to have been held at London's Alexandra Palace in late October was called off because of a general lack of interest.

Last year saw the first Hobbies Fair take place at almost the same time of year as the established Breadboard show. This meant that both shows suffered from a generally poor attendance both in terms of the paying public and exhibitions.

This year Breadboard has survived and will take place later in the year – *E&CM* will be at Breadboard and we will tell you more about the show and our involvement nearer the time.

#### Store Wars

With the competition between manufacturers combining with that between the various retail chains involved with the computer market the prices of computers are a tumbling.

Atari 400s and 800s are now freely available for £100 and £200 respectively—the motive here is to clear stocks of these machines to make way for the soon to be launched 600XL and 800XL (to sell at £159 and £249 respectively).

Another price cut with stock clearing as one motive is the £45 ZX81 starter pack. This consists of a ZX81, a 16K RAM pack and a free piece of cassette software.

Sord's M5 has had £40 taken off its price. This makes the machine £149.95 – still rather expensive and Sord would do well to include the BASIC-G cartridge for this price, the M5 would then be very attractive.

Dragon are to sell their 64K machine for less than £200 and Commodore look set to slash the price of the 64 and to sell the VIC 20 at almost give away prices.

The Electron enters the fray at £199 but may well work its way down to the £150 level by early next year.

Whether the build-up to the Christmas period will start to firm up prices is yet to be seen but, for the moment, if you're on the look-out for bargains, London's Tottenham Court Road is the place to be.

#### States Snub Sinclair

The runaway success of Sinclair products in this country is unlikely to be repeated in the States. The problem is that the machines are just not as competitive in terms of price across the great divide.

For example the Timex TS1500 (Timex have the Stateside Sinclair license) costs \$80. This is basically a ZX81 with extra memory and a Spectrum style keyboard. This undercuts the VIC-20 by only \$10 and the monochrome, low-res display is hardly a match for even the long in the tooth VIC-20.

The US Spectrum lookalike is designated the TS2000 and this sells, in its 48 K version, for \$200 - exactly the same price as the Commodore 64.

Again the TS2000 is a very poor second in terms of performance – would you hesitate in buying a £125 64.

The major problem seems to have been the delay in translating Sinclair designs into their American equivalents. If the Spectrum had been available in the US at the start of last year there is every chance that it would have had a large sale if only for only a couple of months.

#### Circuit Update

Weather Satellite July 1983

The RS crystal oscillator used in this project has been withdrawn. It's replacement does not provide a suitable voltage swing to drive the counter chain.

A circuit that provides a suitable replacement for the oscillator is shown right.

#### **Dragon Cruncher**

Many of you will be aware that both the Dragon 32 and the Tandy Colour Computer are built around the 6809 CPU. The structure of the machine is also very similar and it is therefore not surprising that programs written for one machine can be modified to run on the other.

Elkan Electronic's 'Dragon Cruncher' is a £7.95 cassette based, menu driven program that will convert Tandy Colour programs to run on the Dragon.

The company also distribute four US magazines that regularly publish software for the Tandy machine.

Elkan Electronics 11 Bury New Road Prestwich Manchester M25 8JZ

#### See Us At PCW

Despite the fact that two shows have been cancelled (see elsewhere on these news pages) the end of September sees two shows that run almost concurrently.

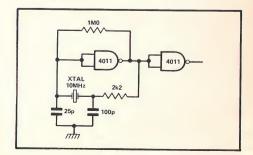
The Home Entertainment spectacular is a new show taking place at Olympia between the 17th and 25th of September.

A few days afterwards sees the start of the now well established PCW show at the Barbican. E&CM will be at PCW along with a number of our sister magazines. We hope you'll come along to PCW and if you do, please seek out the EMAP stand on which you'll find some friendly E&CM faces and a couple of exciting projects from recent issues.

#### **Oric Monitor**

New from Kenema is a powerful Oric monitor. The £15 software package provides facilities that include Memory Display and modification, some powerful program debugging aids and a disassembly display.

Kenema 1 Marlborough Drive Worle Avon BS22 0DQ



# - W - A - N - T - E - D -

# PROGRAMMERS PROGRAMMERS SOFTHITS

MACHINE CODE GAMES
PROGRAMS FOR
ALL POPULAR MACHINES

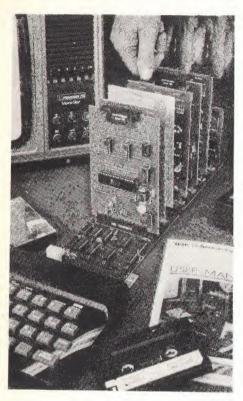
HIGH ROYALTIES AND FEES PAID



SEND YOUR TAPES TO:
ALFRED ROLINGTON
SOFT HITS
SCRIPTOR COURT
155 FARRINGDON ROAD
LONDON EC1R 3AD

#### **COMPUTER PRODUCTS**





#### U Know Who

U Microcomputers has recently introduced an extremely versatile expansion system for the Spectrum.

The initial products in the range are a four slot buffered backplane, a three slot extension backplane – together allowing seven boards to be connected to the Spectrum, a prototyping board and two interfaces.

The first interface, designated the USP – 232D, is a powerful dual channel serial interface designed around the Z80 DART IC. The board provides an LPRINT and LLIST patch.

The second board is a parallel interface built around the Z80 PIO. 16 input or output lines are provided in addition to four control lines. In addition a low cost add-on kit (USP – CENT) provides a cable and LPRINT and LLIST drivers.

Both the interface boards are supported by comprehensive manuals. Further cards are at present under development . . . watch this space.

The expansion system is as yet only available via mail order – prices and additional information from:

U Microcomputers
Winstanley Industrial Estate
Long Lane
Warrington
Cheshire
WA2 8PR

#### Monitoring Oversights

In our monitor of last month we overlooked the activities of Citadel Products who produce a monitor that is both designed in Britain and uses components that do not originate in the Far East.

With customers that include British Telecom, the MoD and Phillips, the 101 monitor obviously has something going for it. The model is a 22MHz unit with a

green P31 phosphor. The 101 costs £89.50 plus VAT and in addition, a 12V version of the unit (RL102) is available at £99.00 plus VAT.

The company also manufacture a comprehensive range of keyboards.

Further details from:
Citadel Products
50 High Street
Edgeware
Middlesex
HA8 7EP

#### Minor Miracles

The Electronics and Computing Monthly RGB interface for the Spectrum has been delayed because of technical problems but news of a new commercial interface with the same aims should make up for any disappointment caused by the delay in our design.

The MI3 interface comes from Miracle Systems, a company formed by ex-Sinclair Research Engineer Stuart Honeyball.

The MI3 is a 'black box' which plugs into the back of the ZX Spectrum and has two BBC Micro compatible 6 pin DIN sockets to provide both TTL and IV p-p linear RGB signals suitable for driving most colour monitors. An MI3 with an RGB monitor gives the user an extremely high quality display since four adjustable components in the ZX Spectrum and the PAL system are completely bypassed—the MI3 even has its own internal 8K CMOS static video RAM. Shimmer and

colour fade problems are eliminated.

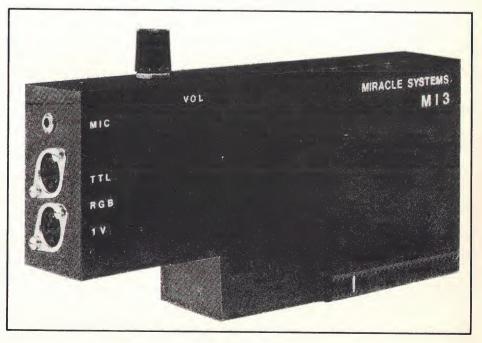
Games users will be pleased to hear that the MI3 also amplifies the ZX Spectrum sound using a 2.5 speaker and volume control.

A 3.5 jack socket located on the MI3 is used in place of the ZX Spectrum's MIC socket so that programmers who frequently use the LOAD and SAVE commands no longer need to insert and remove the EAR jack between these operations.

The MI3 will work with all ZX Spectrum software and does not require any special software to drive it. The ZX Spectrum expansion port is duplicated so that other peripherals may be connected.

Further information about the MI3 may be obtained from:

Miracle Systems Ltd. 6 Armitage Way Kings Hedge Cambridge CB4 2 UE









31 Charnwood Street Derby DE1 2GU

Telephone 0332-380066 (Sales) 0332-369656 (General) Telex CHACOM G 377106 MALECT

## MALISON **EPROM PROGRAMMER**

'ogrammer ★ WRITE OR MODIFY YOUR OWN BASIC, GRAPHICS TABLES OR MONITOR ROUTINES

FULLY BUFFERED FROM YOUR COMPUTER

- BUILT-IN POWER SUPPLY
- ★ ZERO INSERTION FORCE SOCKET AS STANDARD
- COMPREHENSIVE MANUAL
- IDEAL CHRISTMAS PRESENT
- ★ TELEPHONE 'HOT-LINE' FOR TECHNICAL SUPPORT

FOR BBC SYSTFM

Reviewed in E & CM December 1982 Send for FREE Spec. Sheet

THE MALISON EPROM PROGRAMMER is a highly-technology unit and is completely buffered from your computer. It's own built-in power supply has current-limiting on V. P. P., supplies 25 volts or 21 volts switch-selectable. It will program 2516, 2716, 8516, 2532, 2732, 2732A, 2564 and 2764, with no risk of damage – all pins at zero volts during insertion and removal cycles. Built in zero insertion force socket as standard.

COMPREHENSIVE SOFTWARE AND MANUAL. Menu-driven software and fully-documented easy to follow manual supplied with each unit. Allows READ, VERIFY, PROGRAM, EDIT, TEST, COPY, DISASSEMBLE, SAVE and LOAD to CASSETTE features, Ideal for the professional workshop and serious hobbyist alike. Assemble your programs and download to EPROM in one.

FOR THE SHARP M780 BANGE Inexpensive plug-in interfaces available — All £15.25 inc. VAT TYPE M780KB MZ80K — onto rear of computer ..... MZ80A — into expansion box TYPE MZ80AE MZ80B — into expansion box

FOR THE BBC MICROCOMPUTER No interface required, plugs straight onto the BBC Model B.

#### **EPSON PRINTERS**

RX-80 (100cps) £295.65 + VAT = ONLY £340 inc. VAT & DELIVERY FX-80 (160cps) £400.00 + VAT = ONLY £460 inc. VAT & DELIVERY Reliable, Modern and Fast, Find out more about these superb machines and why you should be using one.

#### **BBC MICRO**

Model B 32K RAM - ONLY £399 (next day delivery extra £8.00)

Prices include VAT and Delivery

We will shortly be taking our first consignment of the ACORN ELECTRON orders are now being taken.

#### **COMPUTER BOOKS**

Full range of computer books in stock - Send SAE for full list A.P.L. for the BBC Micro ...... £8.95 Basic Computer Games ..... £6.50 Basic Handbook (2nd Edition) ..... £15.75 BBC Micro Revealed ..... £7.95 Don't . . . . . . . . . . . . £9.65 Intro to Wordstar . . . . . . . . . . . . . . £10.95 Let Your BBC Micro Teach You to Prog ...... £6.45 Micros - Interfacing Techs. ..... £13.10 Peeking & Pokeing The Sharp MZ-80K ..... £4.30 Peeking & Pokeing The Sharp MZ-80A ..... £4.30

#### **ELECTRONIC COMPONENTS**

Send £1.00 to receive our 69 page catalogue, refunded on your first order over £5.00 value.

-	_	_	_		_		_	_			-		 _						1
	0	dor	ta: 1	144	100	N E	150	TD	SALLA	00	TD	ED	 OCT	D	-	VF	151 (	app	

Quantity	Description	Cost
		TOTAL

or Please charge my Access/Barclaycard No.

ECM10 .....

#### **COMPUTER PRODUCTS**



#### Speech Storage System

The limitations of the various forms of speech synthesis systems are mentioned in the 'Sweet Talker' review elsewhere in this issue. A system that overcomes the majority of the shortcomings of such systems is the Voxbox.

This device is capable of storing speech on disc and the reproduced speech retains most of the intonation or stress or the original.

The Voxbox comes complete with full operating software that allows single words, phrases or sentences to be easily stored and manipulated.

The method of digitisation is 'liner delta modulation' (see next month's instalment in our 'optimal coding' feature for an explanation of this technique). There is a trade-off between amplitude and frequency with LDM which means that a choice between either storing high frequencies or large amplitudes must be made. The digitisation rate can be software selected to lie within the range 24-8K bits/second.

The Voxbox is available for £80 as a stand alone unit or for £89 in include software, a speaker and a microphone.

Further details are available from:
Multiplex Computer Services
250 Eastern Road
Brighton
Sussex
BN2 5TA

#### Spectrum Goes Forth

Taking a leaf from the Sony advertising campaign, David Husband has included a Black Cat in one of his views of his latest product – a Spectrum Forth I/O cartridge.

The unit features a 12K implementation of Fig-FORTH, a full RS232 interface, via an 8251, and a total of 24 bits of parallel I/O via an 8255.

In use the Spectrum's BASIC ROM id switched our and replace by the FORTH interpreter. In addition to providing the FORTH language to cartridge endows the Spectrum with a number of other features that include:-

- ★ A multi-tasking FORTH operating system allowing separate Background and Foreground programs to execute simultaneously and transparently of each other.
- ★ A Z80 Assembler for machine code FORTH definitions.
- ★ A built-in terminal routine to support a modem and allow access to bulletinboard systems. This routine can be used from FORTH to BASIC.
- ★ A crystal-controlled baud rate generator for RS232, giving a choice of 8 different baud rates between 765 and 9600 bauds.
- ★ A Machine Code Monitor which can operate in any number base, carry out simple one-line assembly and disassemble.

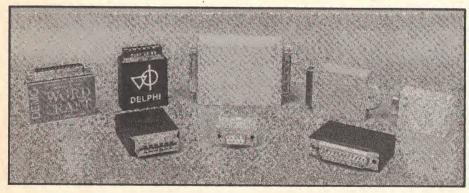


- ★ RS232 and Centronics printer routines, usable from FORTH or BASIC RAM Disc Simulation and support of Microdrives when they appear.
- ★ Full use of the colour, sound and graphics facilities from FORTH.
- ★ Full use of the Cassette routines from FORTH.
- ★ 4K of ROM space is available for future software enhancements, such as floating-point or LOGO.

In order to fully appreciate the facilities of the cartridge a book 'Advanced FORTH', which describes all the Cartridge's features, is available from Sigma Technical Press – the book is included in the purchase price of the cartridge but costs £7.95 as a separate item.

The cartridge is available both from Watford Electronics and from the designer David Husband at:

2 Gorleston Road Brankstone Poole BH12 1NW



#### Day Of The Dongle

Wordcraft Systems have developed a range of software protection devices that have won the rather quaint name of 'dongle' for themselves.

Each dongle contains a unique code which is interrogated during the operation of the program – if a Dongle is not present, or if the Dongle's code differs from that embedded in the software, the program will not run.

This simple idea does not prevent users from making back up copies but, as you need a Dongle at run-time, it does confine

software to a single machine.

Dongles range in price from £2.50 for a VIC 20 variant to £15.00 for an IBM PC version.

Minimum order quantity is 100 and any software authors may well consider giving a dongle with their product – the increased revenue resulting from the elimination of pirate copies should easily pay for the hardware.

Wordcraft Systems 43 Farley Road Derby DE3 6BW

#### Eprom 81

The ZP-4000 is a sophisticated EPROM Programmer designed for use with the ZX81. The unit is fitted between the ZX81 and a 16K RAM pack and features an on board 25V generator, PIO, ZIF socket and a 2K operating system.

The ZP-4000 allows a variety of operations to be selected from its menu display. These include copying PROM to RAM, displaying or editing the RAM image, examining PROM content and a simple transfer to and from BASIC.

The ZP-4000 will handle either 2516 or 2532 of inbuilt safety checks.

The ZP-4000 is available from:
Enterprise Technology
PO Box 140
Wigan
WN3 6LF
at a cost of £63.25 all inclusive.





**COLOUR GENIE** ONLY £168.00 Now with 32K Ram ★ Free Software

**ORIC-1 48K** £139.95 With free software!

**LASER 2000** £69.95

SPECTRUM 48K £129.95

**PRINTERS** MONITORS

**SOFTWARE & BOOKS** 

The very latest for Colour Genie, Oric, ZX81, BBC, Vic 20, Vic 64, Spectrum, Dragon 32, Joysticks, Cassette Players, Add ons, etc.



MAIL ORDER



We mail order - fast! Phone for details FCM10



#### **CAMBRIDGE COMPUTING**

1 Benson Street, Cambridge CB4 3QJ Telephone 0223 322905

Joystick, Interface & Tape at £29.90

I enclose cheque/postal order for £..... Interface and Tape at £24.00. . . . . . made payable to Cambridge Computing Joystick only at £7.00. . . . . . . . . Limited.

# BBC Users NEED MORE ROM SPACE?

The advantages of on board located ROM/EPROM software are rapidly being recognised. They give fast access times (comparable with Floppy Discs), and require no external hardware. In addition they give high reliability and there is little or no risk of mechanical damage to your precious programs.

As a result of this recognition an every increasing number of ROM software packages are being developed, and users are requiring to increase the sockets available to take advantage of the maximum number of ROMs capable of being supported by the computers' operating system.

#### THE ATPL SIDEWISE ROM BOARD

- ★ Increases the ROM software package space available to 16-28 pin sockets. (Which allows you to store your 16 most common programs on board within the computer housing, all available on command with very fast access speeds and requiring no external hardware).
- ★ Fully buffered address and data busses allows problem free access to all 16 sockets.
- ★ Simply plugs in internally with no soldering required.
- ★ £38 + £1 Carriage + VAT
- ★ 16 K battery backed CMOS RAM option to above Allows RAM to be treated as ROM to provide 16 K of non-volatile memory. An additional advantage of this option is that it permits development and editing of software packages before committing to EPROM using the ATPL EPROM PROGRAMMER Price on application.

#### ATPL EPROM PROGRAMMER with AUTO RUN

- ★ Ideal for use in Education, or by Development Engineers, Software Houses, Computer Clubs etc.
- ★ Program, read and check for blank the following 24 & 28 pin single rail EPROMS 2516, 2716, 2532, 2732, 2564, 2764, 27128 & 27256.
- ★ Fully automatic configuration and verification.
- \* Automatically runs user program.
- ★ Load or dump Data files or programs (Basic or machine code) from/to cassette.
- ★ Complete with all software, cables and fully comprehensive instructions.
- ★ For use with cassette, disc or EPROM copy.



#### **EPROM ERASERS**

For erasing up to 6 EPROMS each pass.

With timer £60.00 + £1 carriage + VAT

Without timer £49.00 + £1 carriage + VAT

## **ELECTRO & GRAPHIC PRODUCTS**

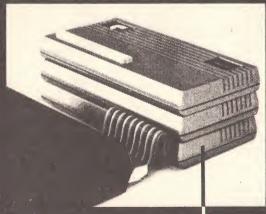
37 Darton Road, Cawthorne, Nr. Barnsley, South Yorkshire ST5 4HU Telephone: 0226 790609

#### LITERATURE RECEIVED

Each month we receive far more books than it is possible to review in the limited space available to us. In future we hope to expand our review section but for now, we'll publish details of those books recently received together with brief details of the publisher, number of pages and price.

TITLE AND PUBLISHER  Mastering Electronics – J. Watson  Macmillan Press	PAGES 379	PRICE £10.00	TITLE AND PUBLISHER Beginners Guide for Computers – T. Fry Newnes Tech Book	PAGES 186	PRICE £4.35
Assembly Language Programming for the BBC – Renko/Edwards		£7.95	Commodore Machine Code Master Sunshine	191	£6.95
Logic Programming – Peter Ross Addison/Wesley	249	£8.95	The Apple II Circuit Description – W. Gayter Howard Sams & Co. Inc.		£19.50
Spectacular Games for your ZX Spectrum Addison/Wesley	145	£3.95	1 APX 88 Book Reston Pub. Inc.	77	£11.00
Terrific Games for your Tandy Colour Addison/Wesley	145	£3.95	Electronic Prototype Construction – S. Kasten Howard Sams Inc.	398	£15.25
Volcanic Games for the Vic 20 Renko/Edwards	131	£3.95	Mastering PASCAL Programming – E. Huggins MacMillan	269	£10.00
Tantalizing Games for Your T199/4A Renko/Edwards	151	£3.95	The Spectrum Programmer – S. Gee <b>Granada</b>	137	£5.95
The Vic 20 Games Book Granada	129	£5.95	The World Connection Howard Sams Inc.	141	£8.45
Science and Engineering Source Book Prentice-Hall	91	£8.45	Computer Communication Tech. Howard Sams Inc.	140	£13.55
Newnes Book of Personal Computing Newnes Technical Book	127	£6.95	The BBC Micro Book Addison/Wesley	347	£7.95

# Turn 1 Ram 64 Tinto a massive 256K of memory in 4 moves!



#### JUST 10 REASONS WHY YOU NEED A ZX81 PERSONA

- 1 Facility to reset a crashed system without pulling the plug.
- 2 Extra lines for one megabyte expansion.
- Din 41612 standard connector. Perfect contacts for 64 goldplated connections.
- 4 Gold-plated connector for firm connection to the ZX81.
- 5 Reliable power connection plus battery back-up points for failsafe operation.
- 6 Controller to co-ordinate all peripherals.
- 7 Circuitry to supervise and maintain memory add-ons.
- 8 Power drivers to minimise loading on ZX81. More expansion with no troubles
- 9 Extra sources of power supplies to eliminate overheating on the ZX81.
- 4" of high quality ribbon cable at no extra cost.

ORGANIC MICRO — YOUR KEY TO THE TOWER OF POWER —

ORGANIC MICRO is a Building Block system. Each module plugs into each other giving you a complete (and modular) range of options. Each module performs its own function or works in conjunction with each other to provide integrate functions. Of course, in order to achieve this you need the right "Foundations". The foundation is the direct interface which we call PERSONA; it is the "Brains" of the whole operation and simply plugs into your Computer. Thereafter, any upgrade facility you need is neatly stacked into the PERSONA, either permanently or when required. In short, an ORGANIC MICRO will save you forever, no matter how big you want to grow.

#### **HOW TO ORDER**

To purchase any of the above items, please fill in the coupon below with your name and address enclosing your cheque or Postal order. Should you need any further information you may telephone us during normal working hours, send for our Brochure, or enquire at GREENS, DIXONS, W. H. SMITH or BOOTS. Move into the Computer world with ORGANIC MICRO — ORDER NOW!



BASICARE
MICROSYSTEM LTD.,
12 RICKET STREET,
LONDON SW6 1RV.
TEL: 01-385 2135.

You simply chose the following modules you want and plug them in to the PERSONA and turn your ZXB1 or ZX SPECTRUM into a total

Computing package.	
PERSONA ZX81	€30.25
PERSONA ZX SPECTRUM	€45.00
RAM 08 (2K)	€24.50
RAM 16	\$26.75
RAM 64	£76.25
MINIMAP.	€35.95
DROM (2k)	£39.50
TOOLKIT	£22.20
PERICON a	€27.90
PERICON D	€33.75
PERICON C	€41.75
SONUS	€30.15
Options: USE FONT	68.00
Additional 2K for RAM 08	€6.50
Additional 2K from DROM	£7.50
Prices include VAT Postage and Packing	
deliveries. Overseas Orders please add	15% to
prion for ourface mail	

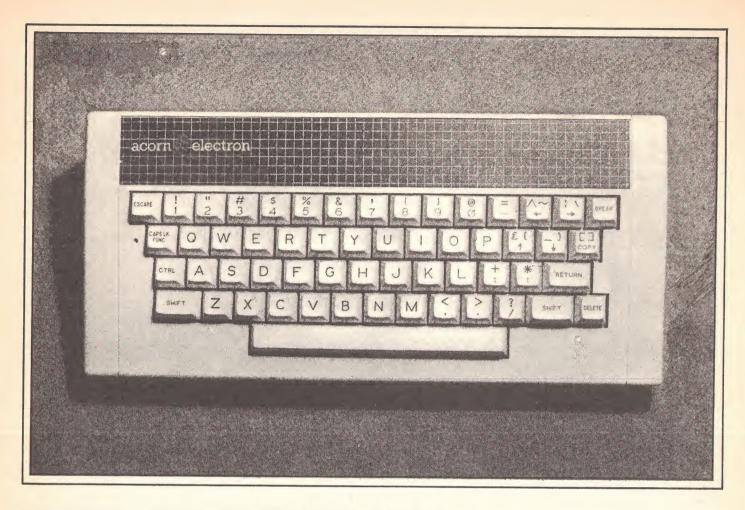
Post to: BASICARE MICROSYSTEM LTD
12 RICKET STREET, LONDON SW6 IRV. Tel: 01-385 2135
Please send me your brochure, I enclose a
large stamped addressed envelope.
I would like to purchase the following items,
(please state irem and No. of items required
from the list above).

I enclose cheque/P.O. for £

NAME:

NAME: COMPANY: ADDRESS:

Tel: (Day) Tel: (Eve) .....



## THE ELECTRON

For £199 the new Acorn Electron offers many of the facilities of the BBC Micro. The questions are what if anything has been sacrificed to produce a lower cost machine and what has the Electron got that the competition hasn't. Mike James reports.

It is perhaps unfair simply to compare the Electron to the BBC Micro and find it wanting. For example, it is all too easy to concentrate on the fact that the Electron is slower than the BBC Micro and miss that point that the Electron is still up with the front runners when it comes to spped! In the same way that Electron may not have three sound cahnnels and a complex ENVELOPE command but its sound capabilities are still very good when compared with other machines in the same price bracket. It's a sure bet that in the future we will hear a great deal of criticism of the Electron based on a comparison with its more powerful stable mate but this is to overlook two of its very remarkable features—its small, compact size and its small, affordable price tag. The Electron is a high performance machine in its own right and it is this fact that should never be overlooked in the course of all the inevitable comparisons.

The Electron is the third personal computer to be produced by Acorn. The first was the well known Acorn Atom, the second was the even better known BBC Micro and now we have the Electron. The only sign of uneven progress in Acorn's machines are their names. In the case of the Atom and the Electron Atom displayed a clear cut preference for physics in a way that other manufacturers prefer fruit! The reason why Acorn didn't name their second machine Positron, Neutreno or Higgs Boson is well known to everyone. The BBC part of the BBC Micro's name certainly brought an excellent machine to the attention of the public rather more quickly than just good reviews in computer magazines and working to gain the approval of an outside

organisation rather then to just produce what was technically easy must have added to the quality and overall usability of the machine. However, the price that Acorn have had to pay for these advantages is high.

Readers of E&CM might be clear that Acorn make the BBC Micro but my guess is that much of the new Electron's potential market will wonder who Acorn are! Of course Acorn will be able to make reference to the success of the BBC micro in their advertising but my guess is that they will have to work hard to promote it.

#### Outline Of An Electron

The Electron is a physically small machine. However, to say that it is 13 inches by six and a half inches by one and a half inches fails completely to convey the good looks and 'chunky' feel of the machine. The typewriter-style keyboard is made of the same cream plastic as the rest of the case. Although there are fewer keys than on the BBC micro the Electron has some surprises in store. On the front face of every key, and surprisingly visible in brown lettering, is a BASIC keyword, making it possible to enter BASIC programs using single keystrokes in the style of the Spectrum. The top row of keys double as programmable function keys — a very useful facility.

Setting up the Electron is simplicity itself. All the necessary connectors – for a UHF modulator, video signal, RGB monitor and cassette are to be found neatly lined up on the left hand side of the case. A 'raw' power input socket is positioned on the righthand side

and accepts the plug from the separate transformer. The practice of building the power transformer as a separate unit is almost the standard for low cost micros and the Electron is no exception with a built in 13 Amp plug in a rather large cream unit. Underneath the Electron's case is a recessed PCB connector intended for expansion modules. The fact that there are two moulded screw threads on either side of the connector (obviously intended to be used to secure such modules) is a clear indication of how well thought out the Electron's design is.

In use the Electron is very pleasing. The keyboard feels good and the video display is clear and steady. The small size of the Electron is a bonus in that it leaves so much space on the desk top for tape recorders and books while you are working with it.

#### Hardware

The Electron's hardware is superficially very similar to the BBC Micro's. Its 32K of RAM, 32K of ROM, double speed 6502, graphics modes and sound generator give is a specification that matches the BBC Micro in all but the fine detail. However, the Electron is a new machine in that most of these features are implemented using quite different electronics from the BBC Micro. In particular, the role of the video 6845 video generator has been taken over by a single custom ULA chip. In fact you could say that the Electron is built around a double speed 6502 and a very large ULA which handles the cassette, the entire video generator circuitry including the palette RAM and serialiser and the sound effects generator. Thus the Electron's large ULA does the job of two ULAs, the 6845 video generator and the sound generator in the BBC Micro and neither of these familiar components are present. This is clearly an indication of how fast technology, and ULAs in particular, are improving. No doubt next year we will see a complete computer including CPU and RAM on a single ULA, but predictions are always dangerous!

The use of a ULA to perform so many functions is obviously one of the main reasons why the Electron is so small. However, it is mimportant to realise that the Electron is so much smaller than the BBC Micro because it contains none of the on board expansion options. That is, the Electron cannot be expanded to use disks, a printer, joysticks or an econet interface without the use of external modules. Although it is easy to see why Acorn didn't include disks or an Econet interface – these items are expensive and easy to do without – it is more difficult to see why printer and joystick interfaces have been left out. The long term success of the Electron will certainly be influenced by the eventual range and cost of the extra modules necessary to extend its capabilities to more serious and general applications.

The Electron's graphics modes are the same as those on the BBC Micro with the notable omission of mode 7, Teletext graphics, see **Table 1.** 

Any BBC programs that use mode 7 will automatically be run in mode 6 on the Electron. This makes sense because mode 6 gives the same 40 characters by 25 lines of mode 7 but it uses 7K more of memory so you might find that some programs run out of space. Another problem with using mode 6 to replace mode 7 is that none of the special teletext features such as double height characters are supported and teletext graphics just appear jumbled on the screen. No doubt someone will provide a program to make mode 6 look more like teletext and then the only problem will be the shortage of memory. It is clear why mode 7 was left out of the Electron, a teletext character generator is not a cheap component, but this leaves the Electron without a text mode that is economical on memory. Apart from this omission, the Electron offers a wide range of graphics options, from a high resolution two colour mode to a medium resolution 16 colour mode, plus two text each only modes offering 25 lines with either 40 or 80 characters to a line. (For a full list of modes see **Table 1**). Although the Electron generates its graphics using a different method from the BBC Micro, from the user's point of view it is virtually indistinguishable. You can mix text and graphics freely anywhere on the screen and can define your own graphics characters. Any BBC Micro program written entirely in BASIC should run on the Electron without any modifications. But any program that tries to make use of the non-existent 6845's control registers is likely to cause some trouble.

The Electron's sound generator provides only one tone and one noise channel as opposed to the BBC Micro's three tone and one noise channel. However, the same BASIC sound commands are available including a slightly restricted form of the ENVELOPE command. The SOUND command produces a noise without causing BASIC to pause making synchronised sound and movement easy. Using ENVELOPE you can only control the way the pitch varies but only within a preset amplitude pattern. As a result BBC Micro programs will run on the Electron but they don't always sound as they were intended to! However, you can still produce simple tunes and sound effects and the restrictions on the ENVELOPE command might make it easier to use for a beginner!

The Electron is slower than the BBC Micro by a factor that varies from 1.5 to 3 depending on what it is doing. The reason for this speed loss is that its 32K of RAM is organised as four 64K bit chips. Thus it takes two memory accesses to handle a single byte. Of course this extra complication is kept hidden from the user by the ULA but it does slow things down. This reduction in speed is very noticeable when using graphics. However, before leaping to the conclusion that this loss of speed is a major drawback, it is important to realise that while the Electron is slower than the BBC Micro it is far from being a slow machine. By the standard of other micros the Electron is fast! On standard benchmarks it comes out about as fast as the Sirius 1 and the APPLE III and is way ahead of its similarly priced competitors.

The Electron's tape system is the same as the BBC Micro's but only works at 1200 baud. In practice this restriction is unlikely to cause any problems because with a properly aligned cassette recorder 1200 baud is very reliable. However, it is worth bearing in mind that the Electron cannot load 300 baud BBC Micro tapes.

The Electron has no spare ROM sockets so software contained in plug-in ROMs cannot be used without an external module. However, if you are prepared to remove the BASIC ROM then other ROM software that doesn't need teletext graphics or any of the other missing facilities can be substituted. So, for example, Acornsoft's word processor, View, could be used.

#### The Software

The Electron's BASIC is officially called Acorn BASIC but it is in fact virtually identical to BBC BASIC. It includes all of the advanced features that have made BBC BASIC so popular – procedures, local variables, indirection operators etc. This coupled with the fact that it is interfaced to the Electron's hardware through 16Ks worth of Machine Operating System (MOS) that is very similar to the BBC Micro's MOS makes the Electron's software a BBC Micro look alike. The PLOT command has one extra facility in that it will fill a screen line with colour, this opens up the possibility of Electron programs not working on the BBC micro. Most of the appropriate \*FX (operating system) calls are present and the VDU drivers accept the same control codes as in the BBC Micro.

TABLE 1				
Mode	No. of Characters	No. of Pixels	No. of Colours	Memory Used
0	80 x 32	640 x 256	2	20 K
1	40 x 32	320 x 256	4	20 K
2	20 x 32	160 x 256	16	20 K
3	80 x 25	(text only)	2	16K
4	40 x 32	320 x 256	2	10 K
- 5	20 x 32	160 x 256	4	10 K
6	40 x 25	(text only)	2	8K

A welcome feature of the Electron is the presence of a 6502 assembler in ROM. This can be used to mix BASIC and assembler in

a way that is particularly suited to the beginner. The only difference between the Electron assembler and the BBC Micro's assembler is the provision of some new pseudo ops that can be used to store constant data in memory. This is a useful improvement but again raises the possibility that Electron programs might not be compatible with the BBC Micro so such features have to be used with care if developing programs for both machines is of practical concern to you.

#### Documentation

The Electron comes with a manual that is heavily based on the BBC Micro's manual and so it is a weighty tome suitable for holding doors open! It gives a good introduction and summary of Acorn BASIC, the MOS and assembler. The section on assembler has been much extended and now shifts the manual's balance away from BASIC. For this reason among others Acorn are supplying "Start Programming with the Electron" by Masoud Yazdani with every computer. This is a short introduction to BASIC for the complete beginner but it does cover rather too much ground for its 117 pages. Rather more interesting is the introductory cassette that comes free with the Electron. This includes quite a few games and demonstrations that can be listed and examined to find out how to do some quite advanced things.

#### Electron vs BBC Micro

It has been impossible to avoid continually making comparisons between the Electron and the BBC Micro because the Electron is best summed up as a 'stripped down' BBC Micro which runs slower. It is stripped down in the sense that it has all of the features of the BBC micro apart from teletext graphics mode, a second cassette speed, space for extra ROMs and the full range of interfaces. Specifically, it lacks a serial interface, joystick interface, 1 MHz and Tube interfaces and the printer and user ports. It will be possible to add all of the missing features apart from teletext graphics and 300 baud cassette loading. However, the question really is why would anyone prefer to buy the Electron rather than a BBC Micro?

The most obvious answer is price. The Electron provides a low cost route into the world of 'BBC computing'. In other words, with the Electron you can take advantage of all the software, the books and the media razamatazz that has been attendant on the BBC's Computer Literacy Project. Although you will have the possibility of up-grading to a fuller system as finances allow the Electron is a more than adequate computer as it stands. It has a specification that makes it suitable for use as a games computer, an educational computer, a graphics computer, a low cost development system... And by adding only one or two of the promised expansion modules its range is likely to be even greater. The Electron doesn't entirely fill the role currently occupied by the BBC Micro but there are many applications that the Electron can be used in at lower cost and without a noticeable loss of performance.

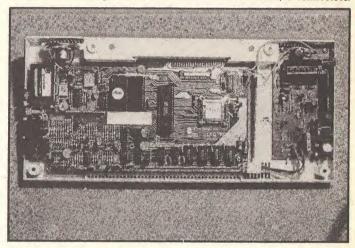
#### Software Compatibility

An important feature of the Electron is ist ability to run programs designed for the BBC Micro. To try to discover just how compatible it really is a few BBC Micro programs were tried on it. The first surprise was that all of the programs contained in "21 Games for the BBC Micro" loaded and ran immediately. The reason why this was a surprise is that some of the programs are very large and use Mode 7 for output. Although they all worked without error, the slower speed of the Electron made some of the games unplayable. However, as all of the programs contained delay loops to slow them down in order to run on the BBC Micro, correcting this problem was easy. A more worrying problem was the way that the sound effect came out differently. A rifle shot in one program sounded more like a car horn! This would obviously need more work to correct.

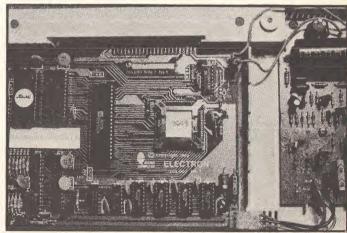
After trying this wide range of BASIC programs the next thing to try were some large Acornsoft programs. Some of these worked after a little coaxing. The main trouble was that in each case the initial loader program used mode 7 teletext graphics and this just came out as a random jumble. However, once the main program was loaded and running most of the programs put up a good attempt at working



The four sockets at the right hand edge of the case provide UHF and composite video outputs as well as the RGB and cassette I/O connectors.



The Electron features the same switch mode PSU as the BBC Micro (board at right of case). The main PCB shows a dramatically reduced chip count compared to the BBC.



Moving in for a closer view of the Electron's ULA (centre). This incorporates the video and sound controllers as well as the cassette I/O and various control and decode functions.

apart from the decrease in speed noticed earlier. The exception to this was PLANETOID which relies on using the 6845 to produce horizontal scrolling. Without the 6845 the result was unusable!

The conclusion to all this is that the Electron really does behave as predicted. A program that makes no direct use of the BBC Micro's hardware will run on the Electron – it may sound a little different and work slower but it will run after a fashion. This should mean that most of the software companies including Acornsoft should be able to offer Electron versions or even dual BBC/Electron versions of their programs very quickly.

Call Column		In Single sided 2N2905	28p 40411 2.85 BC547A 14p	L OBIOKI EV	NOOD ELECTE	CALLOCATO	
Company	RESISTORS 2 2 350 3.3 25 3.3 40 5% HI-STAR 3.3 63	100 × 160 1.55 2N2905A 2 10p 100 × 220 1.90 2N2906 2 11p 203 × 114 1.85 2N2906 2 12p 233 × 220 3.99 2N2907	29p 40412 90p BC547B 14p 25p 40673 83p BC548 12p 30p 40822 1.80 BC548A 13p 25p 40871 79p BC548B 14p	40 Cricklewood B	roadway, London NW2 3ET. Tel. 0	1-452 0161. Tlx. 914977.	VEA
No. 12   1.   1.   1.   1.   1.   1.   1.	10Ω to 10MΩ 4.7 25 14 W E24 2p 4.7 40 15 W E24 2½p 4.7 63	9p 100 × 160 1.65 2N2920 8 11p 100 × 220 2.15 2N2923 2 12p 203 × 114 2.21 2N2924	.50 AC125 49p BC549 13p 25p AC126 32p BC549B 14p 15p AC127 32p BC549C 15p 15p AC128 25p BC550 15c	credit cardino, or by a All in-stock items despa	nail order. Callers welcome. All patched same day. Official orders	roducts first grade franchise welcome from Govt. Depts,	ed source. schools, etc.
Column	2W E12 12p 10 25 10 40 METAL FILM 10 63	8p Developer for 2N2926 12p above Ido not use 2N3053 14p Scdium Hydroxi 2N3054 6el I500ml 2.50 2N3055	10p         AC132         68p         BC550C         25p           27p         AC141K         28p         BC557         15p           56p         AC142K         28p         BC557A         16p           60p         AC151         51p         BC557B         16p	Quantity discounts nego	tiable.		
Company   Comp	LOW NOISE LEG V	VIRE 2N3250  11p Prices per Metre 2N3251  14p Solid connecting 2N3439	36p AC153 55p 3C558A 15p 36p AC153K 64p BC558B 16p 98p AC176 27p BC558C 17p	E430 5.95 J300 48p J310 53p 1N34A 3	SO4 (400) 40p SO8 (800) 55p Gamp type RC4136 59p TBA500 2.9 TBA500Q 3.1	74156 39p 74LS253 32p 74157 29p 74LS257 29p 74159 75p 74LS258 35p	4518 39p 4519 29p 4520 48p
Company	LOW OHMIC 47 25 GLAZE 1/W 47 63	21p Mains/Speaker 2N3441 1 14p Cable 2N3445 1 17p Twin 1 amp 14p 2N3446 1	1.35 AC187K 28p BC559C 17p 4.80 AC188 25p BC560 15p 6.09 AC188K 40p BC560C 25p	MJ900 2.90 1N823 9 MJ901 3.10 1N914 MJ1000 2.50 1N916	2p PW01 (100) 50p TBA510Q 3.09 Ap PW02 (200) 78p TBA520 2.5 Ap PW08 (600) 80p TBA520 2.7 TBA520 2.5 TBA520 2.5	5 74161 48p 74LS261 99p 74162 39p 74LS266 18p 74163 39p 74LS273 54p 5 74164 39p 74LS275 1.25	4526 68p 4527 62p 4528 74p
Section 19	E24 11p 100 16 100 25 100 40	14p 18p 2N3448 6 18p 2N3468 1 22p 3 Core 6 amp 31p 2N3512 2 25p 3 Core 13 amp 2N3553 2	5.56 AF240 1.00 BC651 46p 1.00 BC107 10p BCY70 16p 1.06 BC107A 12p BCY71 16p	MJ1800 3.60 1N4002 47 MJ2500 2.19 1N4003 1 MJ2501 2.25 1N4004 57 MJ2955 1.00 1N4005	5p 25 amp type TBA5300 2.7 5p Metal clad with TBA5400 2.7 6p hole TBA5500 3.2	6 74165 39p 74LS279 29p 74LS280 89p 74LS280 39p 74LS280 89p 74LS283 39p 74LS283 39p 74LS283 4.70	4534 3.96 4536 2.59 4538 · 78p 4539 89p
Column   C	E12 SERIES 100 100 220 10 100 220 16 4 to 7 WATT 220 25	30p   56p   2N3638   16p   Screened Cable   2N3638A   17p   Single   14p   2N3702   22p   Stereo   27p   2N3703	55p BC108 10p BD131 44p 70p BC108A 12p BD132 44p 10p BC108B 12p BD135 40p 10p BC108C 14p BD136 40p	MJ3001 2.25 1N4007 MJ4502 3.99 1N4009 2 MJ15003 4.85 1N4148	7p K02 (200) 2.30 TBA560C 2.8 0p K04 (400) 2.80 TBA570 2.3 3p K06 (600) 3.40 TBA570 2.4 BB BYW64 3.95 TDA1002 3.3	7 74174 54p 74LS293 39p 7 74175 49p 74LS295 74p 74176 39p 74LS298 79p 9 74LS298 79p	4553 2.25 4555 35p 4556 35p
Care	10 to 11 WATT 220 63 112 to 33K 37p 220 100 470 16	30p   Mini Stereo   15p   2N3705   40p   4 Core 4 Screens   2N3706   2N3707   2N3707	10p BC109 10p BD137 421 10p BC109B 12p BD138 391 10p BC109C 12p BD139 39 10p BC140 29c BD140 39	MJ15015 2.45 1N4448 2 MJ15016 3.34 1N5400 1 MJE340 53p 1N5401 1 MJE350 1.50 1N5402 1	2p	74178 79p 74LS323 1.59 74180 40p 74LS324 1.45 4 74181 1.15 74LS325 2.96 5 74182 80p 74LS326 2.39	4566 1.49 4569 1.65 4584 39p 4585 59p
Column   C	PRESETS 470 40  ROTARY POTS LOW NOISE 1000 16	33p 8 Core 61p 2N3709 43p 8 Core 61p 2N3710 60n 12 Core 80p 2N3711 30p Aerial Cable 2N3712	10p BC141 37p BD238 98, 10p BC142 29p BD239A 57, 10p BC143 30p BD239A 57, 2000 BC147 10p BD239C 64, 10p BD240A 59, 10p BD240A 50, 10p BD240A	MJE3055 69p 1N5404 1 MPSA05 23p 1N5406 1 MPSA06 25p 1N5407 1	Bp         R - Red         TDA2611A         2.5           Bp         G Green         TL061         40           9p         Y Yellow         TL062         60           Op         Large diffused         TL064         99	74185 89p 74LS347 95p 74LS348 88p 74LS348 88p 74LS345 61p 74188 2.50 74LS352 61p	LOGIC
Column   C	53 SERIES 4K7 to 2M LIN 32p 4K7 to 2M LDG 32p 1000 40 1000 63 2200 16	46p 75Ω UHF 36p 2N3714 65p 75Ω VHF 28p 2N3715 40p 300Ω Fiat 14p 2N3716	2.98 BC147B 10p BD241A 61; 3.31 BC148 10p BD241A 61; 3.60 BC148A 12p BD242A 65; BC148A 12p BD242A 65;	MPSA12 29p 1N5024 5 MPSA13 48p 1S44 1 MPSA14 46p BA102 2 MPSA16 30p BA115 2	2p	hp 74191 48p 74LS362 7.25 p 74192 45p 74LS365 29p p 74193 45p 74LS366 29p p 74194 40p 74LS367 29p	2650A 11.99 6502 3.24 6800 2.10
AGALLA J. C. S.	DP mains 2200 40 2200 63 25 25 25 25 25 25 25 25 25 25 25 25 25	70p Cable 2N3819 134p Prices per foot 2N3820 75p 8 Way 25p 2N3821 89p 10 Way 25p 2N3822	36p BC148C 13p BD243A 72 38p BC149 10p BD243C 85 1.84 BC149B 12p BD244A 82 90p BC149B 12p BD244A 82 80 BC149C 13p BD244C 1.0	MPSA20 43p BA138 3 MPSA42 49p FA142 2 MPSA43 49p BA156 3	0p R2D 8p 6p TL084 89 0p U2U 12p 10p UAA170 1.6 5p Y2D 12p 10p UAA180 1.6 8p Micro 0.1" ULN2003 85	74196 45p 74LS373 55p 74197 39p 74LS378 68p 74198 79p 74LS386 1.14	6809 6.20 8035 3.49 8080A 2.50 8085A 3.49
Commonword   Com	PRE-SETS PIHER Wires one en Matsushita of	PCB. 20 Way 48p 2N3824 dl 24 Way 62p 2N3866 only 30 Way 75p 2N3903	1.70 BC152 35p BD245C 1.3 90p BC153 23p BD246A 1.2 13p BC157 11p BD246C 1.3	MPSA56 30p BA157 2 MPSA65 40p BA158 3 MPSA66 47p BA159 3 MPSA70 45p BA182 4	0p G1D 27p 25p UPC1156 2.7 2p Y1D 27p 25p XR2206 2.9 0p Large clear ZN414 1.0	74LS393 42p 74LS395 89p 74LS396 1.90 74LS398 2.70	Z80A 2.98 Z80 8 8.60
Comparison   Com	Mini Vertical 15p 10 16 Mini Hzontal 15p 22 10 Standard Vert 18p 22 16 Standard Horiz 47 10	6p 6p 64 Way 88p 2N3905 6p 64 Way 1 49 2N3906 7p RECHARGE 2N4031	13p         BC157B         13p         BD249C         2.3           13p         BC158         10p         BD250A         2.1           75p         BC158A         12p         BD250C         2.4           65p         BC158B         13p         ED419         1.2           65p         BC158B         13p         ED419         1.2	MPSA93 39p BA202 2 MPSL01 42p BA316 2 MPSL51 48p BA317 4 MPSU01 84p BA318 3	6p G5C 17p 13p ZN1034 1 9 15p Y5C 17p 13p Super bright high 10p efficiency	9 74LS01 15p 74LS445 99p 74LS02 15p 74LS490 2.20 74LS03 15p 74LS540 89p 74LS04 15p 74LS541 1.20	2114 (200ns) 99p 2532 2.98 2564 6.25 2764 4.25
CATALOUSE  CHARLET BY  FIG. 25. 10.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1	CERMET 20 100 10 TURN PRECISION 220 10 PRE-SETS 220 16	9p 10p 11p 11p 11p 12p 12p 12p 12p 12p 12p 12	63p BC159A 12p BD437 88 49p BC159B 13p BD438 88 3.00 BC159C 18p BD439 9C 2.26 BC169C 42p BD440 91	MPSU04 1.32 BAV10 1 BA	15p times brighter) 15p R5U 38p 29p 7400 16p 16p G5U 42p 34p 7401 16p	74LS08 15p 74LS10 15p 74LS11 15p CMOS	2716(5V) 2.10 4116 (200ns) 99p 4118-3 3.25
Commonwealth   Comm	501 to 500K 89p 470 10 470 16 1000 10 1000 16	17p charge up to 1,000 2N4400 18p times 2N4401 4.75 2N4401 4.75 2N4402 4.75 2N4403	15p	MPSU55 58p BY126 MPSU56 59p BY127 MPSU57 1.20 BY134	Rectangular 7403 16p Stackables LEDs 7404 16p R6L 17p 7405 16p G6L 18p 7408 14p	74LS13 15p 4000 16p 74LS14 24p 4001 16p 74LS15 15p 4002 16p 74LS20 15p 4006 49p	5101 (450ns) 1.89 5204 7.50 6116 3.85 6514 3.30
Sept.   Company   Compan	DISC (PLATE) E12 MICRO-MINI typically -5% EORME	HP11 (1.2AH) 2.29 2N4410 PP3 4.95 2N4427 Chargers 2N4870 TYPE H: 2N4871	42p BC168B 10p BD536 75 79p BC169C 10p BD537 80 80p BC169 10p BD538 80 55p BC169B 10p BD538 80	JUSI	7410 15p	74LS21 15p 4007 19p 74LS22 15p 4008 32p 74LS27 15p 4009 24p 74LS28 15p 4010 24p	6810 1.15 7489 1.65 74189 4.00
Comparison   Com	POLYCARB 5% SIEMENS 7.5mm 12:0 12V. MINI-BLOC E12 15:0 15V	Mary 9V. above f15.59 2N4902 2N4902 TYPE M. As above but 2N4904	1.69 BC169C 10p BD539C 1. 1.85 BC177 16p BD540 88 1.85 BC177A 25p BD540C 1. 1.98 BC177B 26p BD675 7. 215 BC177B 26p BD675 7.	CATALOGUE	CA3048 2.15 7420 15p CA3059 2.80 7421 19	74LS32 15p 4012 19p 74LS33 15p 4013 19p 74LS37 15p 4014 46p	74LS287 3.05 74LS288 2.25 MISC LOGIC ICs
Top	1nF to 6n8 7p 8n2 to 47nF 8p 20 0 20V 56nF to 150nF 10p 1.25	A £2.65   charges 4AH   2N4905   2N4906   2N4906   2N4906   4 faster   £25.95   2N4908   2N49	2.75 BC178A 24p BD677 71 2.99 BC178B 25p BD678 8: 3.20 BC179 20p BD711 1.	£1.00 inc.VAT, p	CA3190AQ 3,70 7422 19p CA3130E 87p 7423 19p CA3130T 1.80 7425 19p CA3140E 39p 7426 19p	74LS42 28p 4017 32p 74LS47 35p 4018 45p 74LS51 14p 4019 25p	ADC0816 14.90 ADC0817 10.06 INS1671 20.80 INS1771 20.00
Affire   South   Affire   Af	100nF to 150nF 11p 180nF to 270nF 14p 0 · 6 · 6 · 9	/A 4.35 TYPE A: 2N4918 /A 8.95 a time) £5.85 2N4920 2N4920 2N4921	65p BC197C 27p BDX66B 5 75p BC182 10p BDX67B 55 85p BC182A 12p BDY54 1.	7 TIP29C 38p TIP30A 35p TIP30C 36p TIP31A 33p	HA1366W 2.40 7428 26p HA1388 2.54 7430 14p ICL7106 6.85 7432 22p ICL7107 9.50 7433 22p	74LS75 14p 4021 39p 74LS73 18p 4022 39p 74LS74 18p 4023 19p 74LS75 18p 4024 32p	RO2513UC 6.50 SAA5000 3.00 SAA5010 7.10
	20p These god 470nF to 560nF heavy send 26p p&p. We	ds are d extra   ANTEX SOLD   2N4923   2N5086   2N5087	69p BC182L 10p BDY56 1. 99p BC182LA 13p BDY57 5. 36p BC182LB 14p BDY58 6. 39p BC183 10p BF194 1	100 TIP32A 38p 4, 8 & 12 A 15 TIP32C 42p Texas TO 17 TIP33A 65p Suffice: A 17 TIP33C 78p B 200V	100V ICL7556 1.50 7441 55p	74LS78 19p 4026 79p 74LS83 36p 4027 19p 74LS85 41p 4028 39p	SAA5020 5.50 SAA5030 9.00 SAA5040 15.00 SAA5041 15.00
100   150	POLYESTER 250V RADIAL (C280) VER	NS240 (25VV) 3.25 (2N5089 2N5190 2N5191 2N5240 2N5191 2N5191 2N5191 2N5193	3.p BC183A 11p BF196 1 68p BC183C 13p BF197 1 70p BC183C 13p BF197 1 90p BC183L 10p BF198 1	P TIP34C 88p D 400V P TIP35A 1.09 M 600V TIP35C 1.28 TIC106/	LC7130 3.20 7443 89p LC7137 3.95 7444 89p LF347 1.50 7445 49p LF351 47p 7446 59p	74LS90 24p 4030 19p 74LS92 29p 4031 1.19 74LS93 24p 4032 79p 74LS95 39p 4033 1.20	SAA5052 8.50 SAA5070 16.95 TMS6011 3.65
Sept.   Sept	10nF, 15nF, 22nF, 22nF, 23nF, 47nF, 68nF, 25 3.75 100nF 7p 2.5 5 5 150nF, 220nF, 10p 3.75 3.75 3.75	83p No. 2 (Small) 85p 99p No. 3 (Med) 85p 2N5245 2N5246 2N5246 2N5246 2N5246 2N5247 2N5249	79p BC183LB 13p BF2200 1 37p BC183LC 14p BF224J 3 40p BC184 10p BF225J 3 45p BC184 12p BF244A 3	TIP36C 1.39 TIC106C P TIP41A 49p 4A TIC106C TIP41C 55p TIC106C TIP42A 55p	48p LF355 92p 7447 39p 0 49p LF356 92p 7448 49p 0 68p LF357 1.09 7450 15p 1 1598 4 69	74LS107 35p 4035 44p 74LS109 23p 4036 2.49 74LS112 22p 4037 1.13	8T28 1.20 8T95 85p 8T97 85p 81LS95 80p
Mich Vol. 17	680nF 18p 2.5 , 17 1µF 22p 3.75 , 17 1µ5, 2µ2 39p 4.79 , 17 VQ Board	2.99 No.50 (Smalll 85p 13.85 No.51 (Med) 85p 4.93 No.52 (Lgel 85p 1.92 SOLDER 125gms	48p BC184L 10p BF245A 3 2.88 BC194LB 13p BF245B 5 98p BC184LC 14p BF246 5 1.28 BC184C 14p BF246 3	P TIP49 1.20 TIC1168 P TIP50 1.40 8A TIC1160 P TIP53 1.57 TIC1161 P TIP54 1.58 TIC1161	8 68p LM3392 1.19 7454 14p 7460 15p 7460 15p 7470 34p 80p LM350K 4.60 7472 25p	74LS114 22p 4040 40p 74LS122 32p 4041 40p 74LS123 36p 4042 39p 74LS124 89p 4043 39p	81LS97 90p 81LS98 85p 6522 3.19
Pens. Sepond 3.53   Sepond 3.54   Sepond 3.55   Sepond 3	1nF 500V 7p Track Cutte 100 Pins Veroblock	3.90 18 swg 2.95 2N5401 2N5415 55p 3.99 PLUGS & 2N5416 2N5447	35p BC187 24g BF2478 5 1.10 BC212 10p BF2478 5 1.54 BC212A 12p BF2478 5 16p BC212B 13p BF254 3 16p BC212B 13p BF254 3	P TIP110 74p TIC126/ P TIP112 90p TIC126/ P TIP115 81p TIC126/ P TIP117 96p TIC126/	A 72p LM380N14 75p 7473 25p 372p LM380N8 1.50 7474 19p 173p LM381NN 2.26 7475 25p 7476 25p 173p LM381NN 1.40 7476 25p 17476 25	74LS126 25p 4045 99p 73LS132 29p 4046 44p 74LS136 24p 4047 39p 74LS138 24p 4048 39p	8154 9.00 8155 3.50 8212 1.10 8216 99p
1.359   14p	many types in stock.  TANT BEADS	ol 3.35 ol 75p 6p 25 Way Solder: 2N5449 2N5449 2N5450 2N5451 2N5451 2N5451	19p BC212LA 13p BF256A 3 21p BC212LB 14p BF256B 4 23p BC213 10p BF256C 6 25p BC213 11p BF2567 3	ip TiP122 73p TRIAC p TiP125 84p Texas 40 p TiP127 84p TO220 Case	S LM383T 3.40 7481 1.19 DOV LM38AN 1.40 7482 63p LM386 88p 7483 38p A) 66o LM38N 2.43 7484 69p	74LS139 28p 4049 22p 74LS145 69p 4050 23p 74LS147 99p 4051 44p 74LS148 75p 4052 58p	8226 2.50 8228 2.19 Z80ACTC 2.60 Z80ADART 5.50
ACC 550   14p   22   525   14p   23   525   14p   24   14p   24   525   14p   24   1	.22·35V 14p MAT .33/35V 14p FERR .47·35V 14p FERR	S Female 2.09 2N5458 PCB Wire Wrap 2N5450 Male 1.60 2N5551	29p BC213B 12p BF259 3 29p BC213C 13p BF259 3 72p BC213L 10p BF457 4 72p BC213LA 13p BF458 6 37p BC213LA 13p BF459 6	TIP132 93p TIC225D16/ TIP135 99p TIC226D18/ TIP137 99p TIC236D13 TIP140 1.04	Al 74p LM391N60 1.70 7485 bbp 1 88p LM391N80 1.93 7486 19p 1.16 LM723CH 95p 7489 1.68 1.16 LM723CN 35p 7490 20p	74LS153 39p 4054 79p 74LS154 79p 4055 83p 74LS155 29p 4056 79p 74LS156 36p 4059 4.35	Z80APIO 2.70 ZN425E8 3.39
4.7/55V 20p 6.8/35V 21p 6.8/35V 21p 10/18P 32p 10/18P 32p 15/18P 30p 15/18P 3	1.0/35V 14p 2.2/35V 14p 3.3/35V 18p 4.7/35V 18p	Ving   Covers   £1.00   2N58.86   2N6.083   2N6.021	5.95 BC213LC 14p BF469 8 5.95 BC214 10p BF470 BF879 2 57p BC2148 12p BFR39 2 57p BC214C 13p BFR40 2	P TIP145 1.15 TIP147 1.15 TIC253D120 P TIP162 4.95 P TIP2955 77p TIC263D125	1.22 LM725CN 3.19 7492 25p (A) LM741CH 96p 7493 25p 1.90 LM741CN 15p 7494 36p (A) LM747CN 69p 7495 36p	74LS157 24p 4060 42p 74LS158 29p 4063 79p 74LS160 50p 4066 22p 74LS161 35u 4067 2.39	- Positive - 100mA 78L05A 29p
10,170	4.7/35V 20p 6.8/25V 20p 6.8/35V 21p 10/16V 18p 2. Thick line 2. Thick line 2. Thick line	RS Line Skts 15p 2N6123 Chas. Skt - 120p 2N6124 es Dual 30p 2N6125 Quad 40p 2N6126	65p BC214L 10p BFR79 2 59p BC214LC 14p BFR90 2 65p BC237 14p BFR81 2 75p BC237 15p BFR90 2	p 11543 40p DIAC: p 11588A 62p BR100 p VN10KM 60p BR100	S LM748CN 35p 7497 89p LM1871 3.25 74100 80p 25p LM1872 4.38 74104 50p	74LS163 35p 4069 19p 74LS164 40p 4070 19p 74LS165 49p 4071 19p 74LS168 84p 4072 19p	78L15A 29p 78L24A 29p 1 Amp T0220
22/16V 28p   9 Mixture of symmetric of the property of the pro	15/10V 22p 15/16V 30p 15/25V 32p 22/6.3V 26p 4. Thick be 5. DIL pad 6. Transist 7. Dots +	TRANS 2N6130 2N6130 2N6131 2N6132 2N6133	93p BC237B 17p BFS61 1 98p BC237C 18p BFS61 1 83p BC238 14p BFS98 1	00 VN66AF 85p 2TX107 10p ZTX108 10p ZTX108 10p	LM1889 3.77 74107 19p LM2907N 2.75 74109 25p LM2907N8 2.60 74110 35p LM2917N 189 74116 50p	74LS169 85p 74LS170 69p 74LS173 49p 4076 45p 74LS174 34p 4077 19p 74LS175 34p 4078 19p	7812T 39p 7815T 39p 7824T 39p - Negative
100/13V 32p   25.149   3.50   45.00	22/16V 29p 33/10V 30p 47/3V 14p 47/6.3V 34p 47/16V 39p	et of our vast stocks. 2N6253 2N6254 2SC1306 2N930 30p 2SC2078	1.36 BC238B 16p BFY50 1.45 BC238C 17p BFY51 1.55 BC239 15p BFY52 95p BC239A 16p BFY52 95p BC239B 17p BFY53	Bp ZTX302 15p ZTX302 15p ZTX303 23p 1 3 Watt ZTX304 15p E24 Series	LM3900 49p 74120 59p LM3911 1.20 74121 25p LM3914 2.50 74122 35p	74LS181 88p 4081 19p 74LS183 1.05 4082 19p 74LS190 36p 4086 4090 74LS191 36p 4086 60p	100mA T092 79L05 49p 79L12 49p 79L15 49p
Panasonic  F   Siemens   AXIALS (Wires each end   Price of the part of the p	100/13V 32p 100/10V 55p GLASS PC Single Sid ELECTROLYTICS 178 × 240r	NE 2N1893 49p 2SJ49 2N2102 39p 2SJ50 ed 2N2217 39p 2SJ82	3.50 BC239C 18p BSX29 3.75 BC300 45p BSX20 4.29 BC301 44p BSX21 4	70 ZTX310 35p ZTX311 32p ZTX312 35p ZTX313 36p BRID0	14p LM3915 2.50 74123 35p LM3916 2.50 74125 30p LM3960 95p 74126 35p MF 10 3.50 74128 35p	74LS193 37p 74LS194 32p 4094 69p 74LS195 32p 4095 71p 74LS196 45p 4096 69p	7905T 44p 7912T 44p 7915T 44p
RESIST PEN 2N/221 A 29 N/201 2 98 B C440 320 BUZ05 1.89 ZTX500 14p W01 100 4bp NE596 45p 74144 1.95 74LS243 95p 4407 37p 44LS244 95p 44D 44D 44D 44D 44D 44D 44D 44D 44D 44	Mainly Matsushita (Panasonic) & Siemens AXIALS (Wires	2N2219A 28p 2N2220 22p 3N128 2N2221 22p 3N120	4.29 BC327 14p BU109 3 1.12 BC328 14p BU126 1 1.07 BC337 15p BU126 1 6.93 BC338 15p BU204 2	95 ZTX314 24p 7	Vn in NE531N 1.36 74132 29p 74136 27p NE531N 2.50 74141 55p NE544N 1.95 74143 1.95	74LS197 48p 4097 2.88 74LS221 95p 4098 74p 74LS240 95p 4099 89p 74LS240 95p 4502 55p	ZIF SOCKET
1 63 8p 5 SLC SLS EPOX 2NJ288 25 19 4008 2.95 ECS48 8p 6 BL008 1.35 ECS4 8p 15 Class EPOX 2NJ288 25 19 4000 7 75p ECS48 8p 8 BL008 1.35 ECS48 8p 8 BL008 2.95 ECS48 8p 8 BL008 2	μFd V 47 63 8p 47 100 9p 47 350 30p PHOTO PERSON IN TO SERVIT IN	N 2N2221A 23p 3N201 2N2222 24p 40360 2N2222A 25p 40361 2N2223 2.60 40362	2.98 BC440 32p BU205 1 60p BC441 33p BU206 1 67p BC460 32p BU208 1 67p BC461 33p BU226 3 67p BC461 33p BU226 3	89 ZTX500 14p W02 (200) 98 ZTX501 14p W04 (400) 96 ZTX502 14p W08 (800) 35 ZTX503 17p	26p NE556 45p 74144 1.95 28p NE558 1.89 74145 38p 40p NE560 3.25 74147 89p NE565 1.18 74148 55p	74LS244 95p 74LS245 95p 74LS247 95p 4510 45p 4511 48p	SWITCHES Toggles (Mini)
	1 63 8p 1 100 9p 1 500 40p 2.2 25 8p 3 SEGISTION 1 151 Class Glass. For results than	Epoxy 2N2368 25p 40406 better 2N2369 19p 40407 spray 2N2369A 20p 40408	2.99 BC517 40p 3U406 1 1.39 BC547 13p 9U407 1 1.58 BC5468 15p BU408 1 1.58 BC5568 15p BU500 2	45 ZTX510 34p Square wit 2TX531 24p S01 (100) 2TX531 25p S02 (200)	NE567 1.37 74151 35p NE570 4.07 74153 35p NE570 4.07 74154 49p NE571 3.99 74155 40p	74LS248 95p 4512 48p 74LS249 95p 4514 1.13 74LS251 29p 4515 1.13	SPDT 55p DPDT 69p DPDT C. off 85p

# EPROM PROGRAMMER FOR THE BBC MICRO

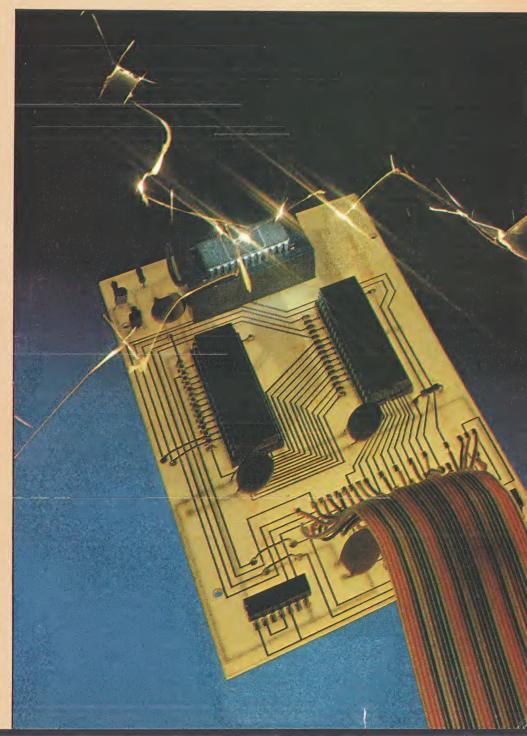
Peter Simpson and Brian Alderwick describe the hardware and software details of an EPROM 'blower' that can program EPROMs for use with the BBC's sideways ROM sockets. Now it's possible to 'blow' your own EPROMs with, perhaps, a machine code disassembler – the limit is set only by your imagination and 16K of memory.

Most users of microcomputers must surely at one time or another have wished for useful routines to be immediately available without having to load from disc or, even worse, having to search through never ending tapes. A facility which avoids these problems, is available on the BBC micro in the form of the sideways ROM sockets. This article describes the necessary hardware and gives a complete software listing for an EPROM "blower" capable of programming EPROMs to fit into these sockets.

Given the facility to "blow" your own EPROMs it is then up to you to write the programs to go into the EPROMs. Perhaps a machine code disassembler or a utility to list BASIC variables and their contents take your fancy — the limit is only set by your imagination and 16K of memory.

An EPROM (Erasable Programmable Read Only Memory) is an integrated circuit which can be programmed by applying certain electrical signals to it. Once programmed, the memory contents can be considered semi-permanent and are retained even when the computer is switched off. If it is required to re-program the EPROM, it must be exposed to "hard" ultra violet light for approximately twenty minutes through the clear window on the top of the chip, after which it is ready for re-use. Hence the EPROM is a very versatile chip not only for one off home use, but also for commercial purposes when the total numbers do not warrant the expense of permanent ROM manufacture.

Because of the restriction in the amount of memory addressable by the 6502 microprocessor, Acorn have provided a way of switching any one of four (potentially sixteen with hardware expansion) alternative banks of 16K into the same part of the memory map. This area is known as the paged ROM area and is located from &8000 to &BFFF (see page 500 of the user guide). BASIC resides in this area as do options like Wordwise, View and the Disk Operating System. Thus the normal limitation of 64K of memory can become 108K in the standard micro and ultimately 304K – Acorn have managed to get the proverbial



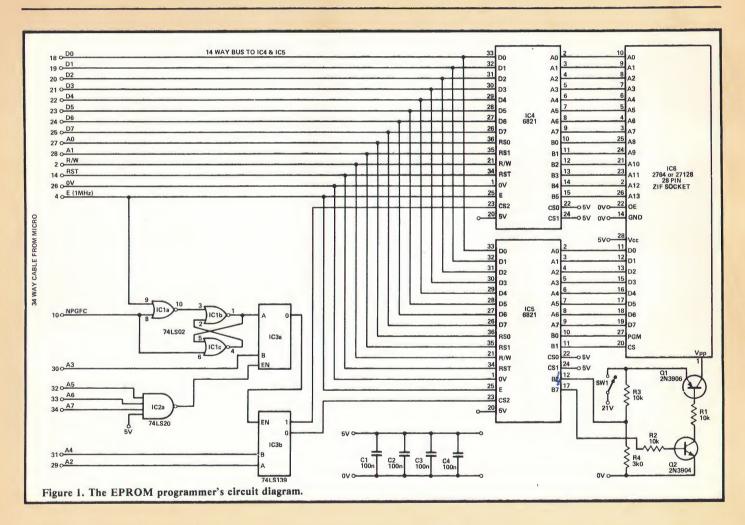
quart into a pint pot! The machine operating system (MOS) needs to be a series one version, that is 1.0 or later since the 0.1 version does not support the paged ROM system. Series one operating systems are now available from ACORN dealers.

The four paged ROMs are located in 28 pin dual in line sockets (IC52, IC88, IC100 and IC101) at the front right hand side of the main board. The fifth socket in from the right (IC51) contains the machine operating

system ROM and should not be touched. One of the paged ROM sockets will already be filled with BASIC and if you have disc drives, another will be filled with the disc operating system. It is interesting to note that if you have a series one MOS, the computer will on power up, select the language ROM which is located nearest to the right.

There are many kinds of EPROMs on the market and this can lead to confusion. The BBC micro will accept 2764 (8K byte) and

27128 (16K byte) EPROMs and it was decided for reasons of simplicity, to design a programmer limited to these two types. The speed rating of the EPROMs should be 300 ns, although the authors have programmed many Hitachi and Intel 450 ns versions and all have worked perfectly. Only these two makes have been tried, therefore they are only types presently recommended for use in this programmer.



#### Circuit Details

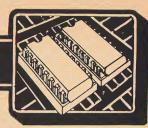
A complete circuit diagram of the programmer is shown in Fig 1. The design is attached to the 1MHz bus and uses the NPGFC and address lines A0 to A7 to decode memory addresses &FCE0 to &FCE3 and &FCF0 to &FCF3 inclusive. These are in the area set aside by Acorn for user applications in the FRED area of this interface. The value of this is that other hardware can be simultaneously connected to the bus, such as the Teletext unit and

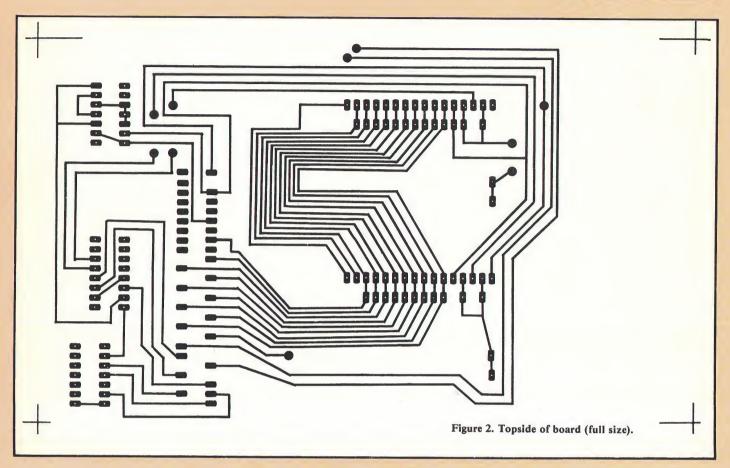
IEEE 488 interface, without causing interference to one another.

The address decoding is carried out by IC1 to 3. IC1 is a quad two input NOR gate and three of these gates are used to "clean up" the NPGFC pulse. IC2 is a four input NAND gate and IC3 a dual two to four line decoder. These decode the above addresses and generate the chip select and register select functions of IC4 and IC5, which are Motorola 6821 Peripheral Interface Adaptors (PIAs).

Ports A and B of IC4 generate the fourteen address lines, whilst IC5 port A generates the data lines and port B various control lines. IC6 is the EPROM to be programmed and a zero insertion force socket is used to hold this chip. Transistors Q1 and Q2 form a switch for the 21 volt programming voltage.

This supply also has a manual switch which acts as a safety measure. The position of the switch is sensed by port B2 on PIA IC5 (Fig 1) and positional change is prompted by the software.





#### Construction

All the ICs are mounted on a double sided printed circuit board which has been designed with home construction in mind, i.e. through links have been provided instead of the commercial practice of using plated through holes.

The layout of the printed circuit board is shown in Fig 2 and 3. When the board is printed the two layouts must be in close register since there is little room for error.

It is important to note that, when drilling the board, all the 34 way cable terminations and, with three exceptions, all the bridge connections, are pads and should not be drilled. These exceptions are at the IC end of the three bridges 'north' of IC4. The bridges can be made from any stiff wire, e.g. scrap resistor ends, but it is important to make sure that the bridges do not make contact with any of the tracks that they are supposed to be bridging!

The components are fitted to the board as shown in Fig 4 and the photograph clearly shows the layout of the finished board. Note that IC1 pin 1 faces 'north' whilst IC2 and 3 face 'south'. Construction is straightforward but is made easier by the use of a small point

soldering iron.

The 34 way insulation displacement cable (IDC) is soldered to the pads on the PCB and the other end is fitted with an IDC 34 way header plug to fit the BBC micro. Make sure pad 1 goes to pin 1 on the plug. The cable should be at least 800mm long.

The constructor is left to make a suitable power supply (5 volts at 300 mA and 21 volts at 60 mA) and provide a housing. With care the zero insertion force socket can be made to fit flush with the top of the case, producing a neat finished product.

#### **Programming Requirements**

Before the software is described it would be a good idea to describe the EPROM programming requirements. Firstly the programming voltage, Vpp (21 volts), should be applied to pin 1 and the chip select line held low. Then to program each byte the address and data lines must be steady and a pulse of 50 ms duration (plus or minus 5 ms) at logic 0 should be applied to the PGM pin 27. Programming a 16K EPROM at 50 ms. per byte takes about 14 minutes.

#### Software Synopsis

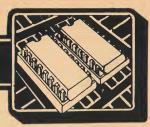
The software makes extensive use of a RAM buffer which physically resides at &3 C00 to &7BFF although the software expects addresses in the range 0 to &3FFF for compatibility with the EPROM addresses. The buffer acts as a temporary store to which the contents of the EPROM can be copied or from which the EPROM can be programmed. A variety of options for manipulating and displaying the contents of the buffer are provided in the software.

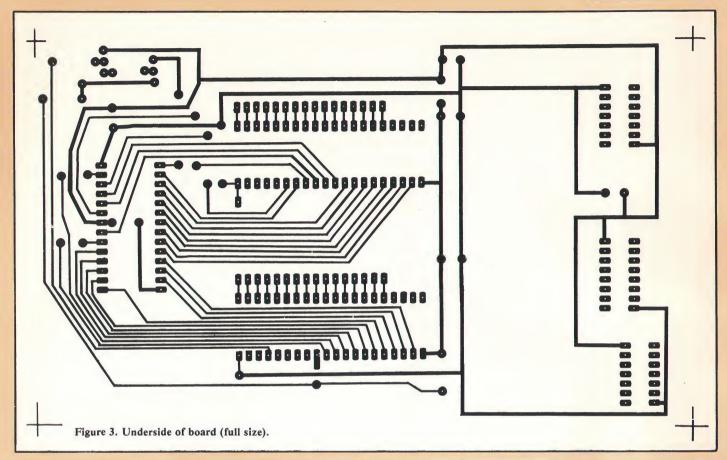
The software has been written to be fully compatible with disc or cassette, the program senses which filing system is in use. Users of disc should choose start up option three which is selected by the command \*OPT 43. This will \*EXEC the short file !BOOT which can be a simple one line file created with \*BUILD consisting of:-

#### 1 CHAIN "EPROM"

Thus a SHIFT/BREAK will autostart the programmer. Cassette users should employ CHAIN "EPROM". The software is split into two parts. The first program is in BASIC and assembles machine-code from &3A00 to &3B98 and it is this which actually

#### **PROJECT**





performs the hard work of reading writing and verifying the EPROM. The second program is also in BASIC and offers a menu of options related to programming the EPROM, at times calling up the machine code routines assembled by the first program. The second program contains many REMs and is too large to fit into the RAM available in a disk based system. However, if line 205 PAGE=&1100, is added to program "EPROM" this resets PAGE, reclaiming some of the disk workspace allowing the programs to run as written. However, this is not recommended and it is suggested that REMs and blank lines are left out. If this is done the programs will run in the normal way with page set to &1900.

For ease of use a menu driven format was adopted. The options provided are shown in Table 1.

When first used the program automatically goes to option 1 to select the EPROM type since this must be provided to allow other options to work.

Each of the options, except number ten, gives the user further options to return to the

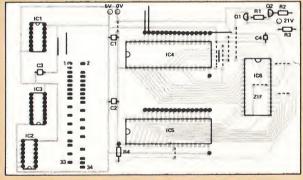


Figure 4 (left). The EPROM programmer's overlay showing the positioning of components.

- THROUGH PINS (SOLDER BOTH SIDES) (IC1-3 SOLDER LEGS BOTH SIDES)
- SOLDER 34 WAY CABLE TO PADS ON TOP OF BOARD
- = POWER SUPPLY CONNECTIONS
- = WIRE BRIDGES ON TOPSIDE PADS
- = WIRE BRIDGES ON UNDERSIDE

#### TABLE 1

- 1 Select EPROM type.
- Transfer disk to buffer.
- Transfer buffer to disk.
- Transfer buffer to EPROM.
- Transfer EPROM to buffer. Verify EPROM against buffer.
- Formatted dump of buffer.
- 8 Load area of buffer with character.
- 9 Change one buffer location.
- 10 Exit.

main menu or to carry on with the one selected. In options 4, 5 and 6 the program uses the buffer from address 0 to the length of the EPROM chosen by option 1.

It takes a long time to program these large EPROMs during option 4 and it was found desirable to give some indication of progress on the screen, to reassure the user that the system was in fact working! To this end the screen displays a dot for each page (256 bytes) to be programmed and as each page is completed the dot is overwritten with a character A. Once the EPROM is programmed it is wise to use option 6 to verify that the EPROM has been programmed correctly. Continued next month.

#### EPROM PROGRAMMER for 12K ATOM and BBC A & B

Designed as a low cost practical solution for the serious computer hobbyist. Program supplied on tape. Plugs into Acorn bus connector on Atom and into user port on BBC machine.

NOTE - 6522 VIA must be fitted to Atom and BBC machine together with appropriate external connectors.

NEW MODEL – Will program 2716, 2532 & 2732 on 12K Atom (larger ROMs if extra memory available). Will program 2716, 2532 2732 & 2764's on BBC Model A and additionally 27128's on the Model B (or 32K'A' with 6522 fitted). MENU DRIVEN - it will:-

- 1. Copy from EPROM into memory
- 3. Verify EPROM against memory
- 2. Copy from memory into blank EPROM

4. Check for blank EPROM

Needs 4 off PP3 batteries (not supplied)

Supplied in a sloping box complete with connecting cable and instructions.

ONLY £29.75 + VAT p&p £1.00

A built-in supply is available in place of batteries for the above.

ONLY £35.00 + VAT p&p £1.00

**ROM EXPANSION CARD FOR ATOM** 

Plugs into utility ROM socket inside case. Allows up to 4 off 4K EPROMS to be software selected. Assembled and tested board.

£13.00 + VAT + 50p p&p

SIDEWAYS ROM EXTENSION RAM/ROM CARD FOR BBC Allows up to 13 additional ROMS to be fitted **OR** 16K of RAM + 5 additional ROMs. Provision also for 2 of the sockets to be used to hold 2764's and to

simulate a 16K ROM. RAM allows programs to be downloaded from disc or tape and run as a sideways ROM.

Also will allow programs to be developed for subsequent insertion into sideways ROM.

High quality PTH Board, assembled and tested.

£29.50 + VAT + £1.00 p&p

**BUTTERFLY BOARD FOR BBC** 

Fits into one of the sideways ROM sockets and allows a 16K program to reside in two low cost 2764's to simulate a 27128 ROM. Built and tested

£15.00 + VAT + 50p p&p



Orders and further details

HCR Electronic Services The Industrial Unit Parker Road Chelmsford Essex CM2 0ES Tel: (0245) 357935 ECM10

#### HARLEY

#### SYSTEMS LTD.

#### ANALOGUE INPUT & RELAY SWITCHING INTERFACES FOR ZX81 & SPECTRUM

ADC8 £50 inc. VAT

Input sensitivities from 0-10 mV to 0-5V 8 channels. 40,000 readings per second in machine code. Ideal for data capture and consequensing, control and games. Monitor most variables without needing an amplifier.

★ HIGH SPECIFICATION MODULES ★

REL4 £55 inc. VAT

HIGH POWER HANDLING.

Max const current 5A Max voltage 250V. 1KW per channel. 4 channels, each with normal open, norm closed and common. Use for control of lights, heaters, motors etc.

★ DAISYCHAIN UP TO EIGHT MODULES ★

HSC1 £15 inc. VAT

Connection cable, required for the first interface module in a chain.

Send S.A.E. for free leaflet or complete the form below NOW

NAME: _ ADDRES						
Please s	send me	Price	Total			1 or Spectrum
	ADC8	£50		H		PPERBOXES.
	REL4	£55				MISSENDEN,
	HSC1°	£12 Postage	£1.00		0	BUCKS, HP16 9PR
I enclos	e a chea	que for £		_ total	ECM10	111 10 71 10

#### THE LARGEST CHAIN OF HOME COMPUTER SPECIALIST SHOPS IN THE U.K.

ECM<sub>10</sub>

**BBC MICRO** 

MODEL B

commodore 64

**DRAGON 32** 

48K MZ-80A

ACORN ELECTRON IN STOCK SOON

#### SOFTWARE

PROGRAM POWER **BUG-BYTE** SUPERIOR SOFTWARE A + FSIMON HESSEL MOLIMERX LLAMASOFT **ACORNSOFT** 

SUPER SOFT

#### PERIPHERALS

DISCS SINGLE/DUAL TORCH Z80 DISCS **CUMANA DISCS PRINTERS JOYSTICKS MONITORS B&W/COLOUR** LIGHT PENS **BBC BUGGY** 

LARGE RANGE OF BOOKS, DISKETTES, CASSETTES & PRINTER PAPER ALWAYS IN STOCK

#### Easy parking at all branches

TOLWORTH 230 Tolworth Rise South, Tolworth, Surbiton,

Surrey KT5 9NB. 01-337 4317

#### SUTTON

30 Station Road, Belmont, Sutton, Surrey SM2 6BS

01-642 2534

#### **EALING**

114 Gunnersbury Avenue, Ealing, London W5 4HB

01-992 5855

#### RICKMANSWORTH

Greystone Works, The Green, Croxley Green, Rickmansworth, Herts WD3 3AJ (0923) 779250

#### **MILTON KEYNES**

Unit 1, Heathfield, Stacey Bushes, Milton Keynes MK1 6HP (0908) 317832

#### **NEWBURY**

26 Stanley Road, Newbury. Berks RG14 7PB

(0635) 30047

Don't miss our November issue

# ON SALE OCTOBER 13th

Britain's Best Selling Computer Projects Magazine

# PULL OUT AND KEEP Home Computer Buyers Guide

Over the past year or so *E&CM* has published reviews of the best selling home computers.

Next month we'll be collating and condensing these articles to present a handy guide to the pros and cons of the most popular machines on sale this Autumn.

The guide will also contain an, as yet unpublished, appraisal of the Atari 400 and 800 models. With these computers now available for as little as £100 and £200 respectively we ask, are they really bargains?

#### BIO-FEEDBACK INTERFACE

Many of you will be familiar with the principles of bio-feedback. The idea is that, by making the mind aware of the various stresses the body is under, it is possible to learn to relax the nervous system.

The E&CM bio-feedback interface measures both the body's heart rate (using a very safe optical sensor) and body heat.

Either of these stress measurements can be displayed in the form of a graph by using the BBC model B micro.

The unit is easy and inexpensive to build and it could lead to a healthier way of life.

#### SPEECH GENERATION

Next month Ian Campbell presents the results of many months of hard research.

His article lists all the major manufacturers of speech synthesis systems together with an examination of the various techniques employed in making machines talk.

#### FLEX SOFTWARE GUIDE

We've persuaded John Chewter, the father of the *E&CM* hi-res computer to take a look at the wealth of FLEX software available in the UK.

The range and quality of software surprised those of us here at *E&CM* and demonstrated the wisdom of designing the hi-res computer as a FLEX based system.

#### **EXCLUSIVE REVIEW**

When the phone went the other day and the person on the other end said that he had just got hold of a brand new computer we were excited.

When we were told it was the only one in the country and that he wanted *E&CM* to be the first magazine to review the computer we could hardly restrain ourselves (luckily we were able to have a few minutes on our bio-feedback machine).

The outcome of all this is that if you want to be the first to read about this new machine – buy our November issue.

Now's the time to catch up with out on 81 and 82.

FRIDAY November 25th

SUNDAY November 27th



SATURDAY November 26th

10am - 6pm 10am - 6pm

10am - 4pm

## THE PREMIER SHOWEORTHE ELECTRONICS ENTHUSIAST!

Cunard International Exhibition Centre, Cunard Hotel. Hammersmith, London W6

Improved Venue

We have transferred BREADBOARD to the Cunard Hotel, offering improved facilities to the visitor, including car parking and ease of access by rail, tube and car, all in a modern attractive setting.

#### Planned Features include

- Lectures: covering aspects of electronics and Amateur Radio Action Centre. computing.
- Electronics/Computing Advice Centre.
- Demonstration: electronic organs/synthesisers.
- Holography presentation.
- Practical demonstration: 'How to produce printed circuit boards'.
- Computer Corner Try before you buy'.

- Computer controlled model railway competition.
- Pick of the projects Demonstration of the best from ELECTRONICS TODAY INTERNATIONAL, HOBBY ELECTRONICS and ELECTRONICS DIGEST.
- Giant TV screen video games.
- Robotic display.

The Breadboard Exhibition is sponsored by Electronics Today International, Hobby Electronics, Electronics Digest and Digital and Micro Electronics

Breadboard'83 ASP Exhibitions 145 Charing Cross Road London WC2H 0EE

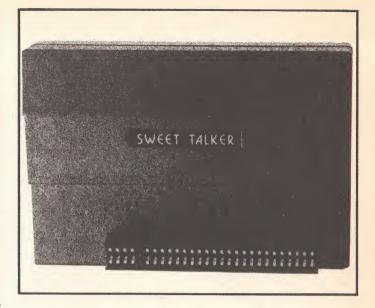
# SWEET TALKER

Ken Alexander lends an ear to Cheetah's Spectrum Speech Synthesiser.

Cheetah's Sweet Talker is an elegant implementation of the allophone approach to speech synthesis. The unit consists of a black plastic box that plugs into the expansion connector on the rear edge of the Spectrum (in common with other add-ons the Sweet Talker makes all these connections available on a PCB 'plug' on the rear of the unit in order that other add-ons can be used in addition to the Sweet Talker). The rear of the unit also features a speaker through which the synthesised speech is reproduced.

The unit is supplied with a brief, yet informative, three page instruction manual and a cassette that introduces the facilities offered by the Sweet Talker in the best possible fashion – by demonstration.

Before going on to describe the module in any more detail, an explanation of the allophone method of speech synthesis is probably in order.



#### Space Saving Technique

There are two major approaches to the electronic synthesis/generation of speech. The first, as adopted by Acorn for the BBC computer, is to store a digitised recording of the words/phrases to be uttered in ROM memory. In fact producing these ROMs is not quite as straightforward as storing the output from an A/D converter fed with the audio signal to be processed. The signal is subjected to various processes designed to reduce the amount of memory required to store the speech. The major drawback with this technique of speech generation is that the words capable of being produced are

Table 1. The	allophone's tha	t the Sweet	Talker can produce
together with	examples of the	ir use are ad	equately described in

10ms		the unit's brief but informative manual.	LETTER	ALLOPHONE	DATA	EVALUE EQ	
30ms			LETTER	ALLOPHONE		EXAMPLES	
50ms			L	LL	45	like, hello, steel	
100ms				EL	62	little, angle, gentlemen	
200ms			M	MM	16	milk, alarm, ample	
LETTER	ALLOPHONE	EXAMPLES	N	NN1	11	before front and central vowels: YR,	
A	*AE					IY, IH, EY, EH, XR, AE, ER, AX, AW,	
A		extract, acting				AY, UW; final clusters; earn	
	*AO	talking song		NN2	56	before back vowels: UH, OW, OY,	
	*AX	lapel				OR, AR, AA: No	
	EY	great, statement, tray		NG	44	string, anger	
	AR	farm, alarm, garment	0	*UH	30	cookie	
-	XR	hair, declare, stare		*AA	24	pottery, cotton	
В	BB1	final position: rib; between vowels;		OY	5	noise, toy, voice	
		fibber; in clusters; bleed, brown		UW2	31	in monosyllabic words: two, feed	
	BB2	intial position before a vowel: beast		OW	53	zone, close, snow	
C	CH	church, feature, cheetah		AW	32		
D	DD1	final position: played, end		OR		sound, mouse, down	
	DD2	initial position: down; clusters: drain			58	fortune, adorn, store	
E	*EH	extent, gentlemen	D	*AO	23	talking song	
	IY	treat, people, penny	P	PP	9	pleasure, ample, trip	
	ER1	letter, furniture, interrupt	Q	KK3	8	before back vowels: UW, UH, OW, OY,	
	ER2	Monosyllables; bird, fern, burn				OR, AR, AO; initial clusters; crane,	
	YR					quick, clown, scream	
F	*FF	hear, earring, irresponsible	R	RR1	14	initial position: read, write, x-ray	
	11	may be doubled for initial position and		RR2	39	initial clusters: brown, crane, grease	
G	GG1	used singly in final position; food	S	SS	55	may be doubled for initial position	
G	GGT	before high front vowels: YR, IY, IH,				and used singly in final position; vest	
	000	EY, EH, XR, guest		SH	37	shirt, leash, nation	
	GG2	before high back vowels: UW, UH, OW,	T	DH1	18	word-initial position: this, then, they	
		OY, AX: and clusters; green, glue		DH2	54	word-final and between vowels:	
	GG3	before low vowels: AE, AW, AY, AR,			0.4	bathe, bathing	
		AA, AO, OR, ER; in medial clusters;		*TH	29	may be doubled for initial position	
		anger; and final position; peg		***	23	and used singly in final position: thin	
Н	HH1	before front vowels: YR, IY, LH, EY,		TT1	17	final clusters before SS: tests, its	
		EH, XR, AE, HE		TT2	13		
	HH2	before back vowels: UW, UH, OW, OY,	U			all other positions: test, street	
		AQ, OR, AR: HOE	U		22	after clusters with YY: computer	
1	*IH	sitting, stranded		*UH	30	full	
	AY	kite, sky, mighty		*AX	15	instruct	
J	JH	judge, injure		ER2	52	monosyllables; burn	
K	KK1				35	vest, prove, even	
	1 31 3 1	before front vowels: YR, IY, IH, EY,	W		46	we, warrant, linguist	
		EH, XR, AY, AE, ER, AX; initial	Υ		49	clusters; cute, beauty, computer	
	KK2	clusters: cute, clown, scream		YY2	25	initial position; yes, yarn, yo-yo	
		final position: speak; final clusters: task	Z	ZZ	43	zoo, phase	
	KK3	before back vowels: UW, UH, OW, OY,			38	beige, pleasure	
		OR, AR, AO: initial clusters: crane,				J	
		quick, clown, scream	*These allophones can be doubled.				

determined by the manufacturer of the speech ROM. To counter this disadvantage, the quality obtainable from a ROM based speech system is very high and some are capable of producing output that is very close to the sound of the human voice.

In order to overcome the restricted vocabularly of a ROM system it is possible, with a fair degree of skill, to 'sound' only part of two or more words and thus build up a new word from sections of those that are available. This sort of technique can extend the scope of such systems and gives a clue to the allophone technique.

#### The Allophone Technique

The term refers to the individual sounds that go to make up a particular word. Table 1 shows the set of sounds that the Sweet Talker is capable of producing together with a list of words which feature the various allophones.

To build up a particular word it is necessary to select a series of these allophones and sound them in quick succession. From this it is apparent that an allophone system demands far more programmer overhead than a ROM system and that the quality of the final result depends very much on the skill with which the programmer can break down the word to be produced into a set of allophones.

#### Speakers' Corner

The Sweet Talker is straightforward to use and, as it draws its power from the Spectrum's PSU and uses its internal speaker to reproduce the speech, setting it up is merely a matter of plugging it into the Spectrum's expansion port.

Loading the software supplied on the demonstration cassette will produce a welcome message on the TV screen as well as 'spoken' instructions. The audio output gives a good indication of the quality of speech obtainable with skillful programming of the unit.

The speech is understandable but not as good as the quality obtainable from ROM based systems – the voice is flat and lacks any intonation. It is very definitely computer speech and could not be confused with the sound of a human voice.

To sound a particular allophone the Spectrum's OUT command is used in conjuction with a DATA statement. For example, to produce the word 'Cheetah' the following program could be used.

Example 'Cheetah'

10 DATA 50,19,13,15,15,0

20 FOR I = 1 TO 6

30 READ A

40 OUT 7, A

50 NEXT I

RUN

The listing for the demonstration tape can be examined and will give the word patterns for many more words. It would however have been of great help if the instruction book had given data strings for some common words, the numerics one to ten and such words as on/off, up/down, left/right for example.

#### Last Word

The Sweet Talker is a well made product that is quite straightforward to use. The quality of speech produced is not up to the standard of ROM based systems such as that used by Acorn but the Sweet Talker does not suffer from any restriction of vocabularly that are evident in all ROM speech synthesisers.

With care at the programming stage any word that is required can be built up from the available allophones and the result will be understandable if not human sounding. The Sweet Talker is an ideal low cost introduction to speech generation techniques.

Cheetah Marketing 359 The Strand London WC2R 0HS

E&-CM





**ADVANCED SOFTWARE** 

#### ZX hardware specialists

Industrial microsystem design and manufacturer

EPROMS for ZX81's

The ZX81 8K EPROM board allows direct access to 4 x 2K 2716 EPROMS or 6116 RAM's. It fits in line with the ZX PRINTER and RAMPACK and contains its own power supply components. The board (or card for use with a mother board) costs £19.95 and comes complete with either EPROM I or II.

costs £19.95 and comes complete with either EPROM I or II.

Further preprogrammed EPROMS are available priced £9.95 each:
EPROM I 40 toolkit routines; EPROM II RAPID SAVE/LOAD, 16K in one minute; EPROM X adds SPECTRUM commands to the ZX81; EPROM IV a machine code monitor; EPROM V a Z80 disassembler.

**EPROMS for ZX SPECTRUMS** 

The 8K SPECTRUM EPROM board is available complete with one programmed toolkit EPROM at £20.95, and can accept a further three 2K2716, 4K 2732 EPROMS or 6116 RAM's. – More software soon.

#### **EPROM PROGRAMMER FOR ZX81 or SPECTRUM**

Programs INTEL 2716, 32, 32A, 64 and 128. ZIF socket £54.75. AUTOSTART; runs a programme stored in EPROM on power-up £9.95.

#### DATA AQUISITION AND CONTROL

A wide range of hardware for control and monitoring purposes. 3 buffered precision analogue output card £26.95. 8 analogue input card in various degree of accuracy, from £23.95. 24 line IN/OUT Cards with various options, from £14.50. 12 input OPTO ISOLATOR £23.95, 48 line MULTIPLEXER £9.95. COUNTER/TIMER £13.95. REAL TIME CLOCK £21.95. 3 slot MOTHER-BOARDS: ZX81 £15.95, SPECTRUM £16.95.

Also Available:

AUDIO GENERATOR £20.95. ZX81 GRAPHICS BOARD £24.50. RS232 Communications Interface £25.95. SPECTRUM RAMPACK Adaptor £6.95. 23 or 28 way Edge Cards 75p, Angle Cards £1.25. 23 or 28 way Gold Edge Connectors £2.50. Gold Edge Cards £2.50.

#### EPROM SERVICES 3 Wedgewood Drive, Leeds LS8 1EF (0532) 667183

Large SAE for details. Export and trade enquiries welcome Prices include UK postage — overseas please add as appropriate Industrial projects undertaken — please 'phone for details Nearly 400 Programmes in stock including Imagine, Bug-byte, Llamasoft, etc. Ring for our Price List

Unit 19, Daniel Owen Precinct, Mold, CH7 1AP. Telephone: Mold 56842

400 inc BASIC £140 800 £290

**48K LYNX £215** 

VIC STARTER PACK £139.99 **DRAGON 32 £175 COMMODORE 64 £229** 

Phone Orders Welcome on 0352-56842

NEXT DAY DELIVERY AVAILABLE Please ring for details:

I enclose cheque/P.O. for £. or please debit my Access Card No.

NAME

ADDRESS

ECM10

## **EPROMs**

**2716** (350nS) ... £2.40 **2732** (250nS) ... £4.00 **2764** (250nS) ... £4.50 27128 (250nS) ... £17.50

We also offer the revolutionary new Modem Chip 7910 compatibile with Bell 113/103/108, Bell 202, CCITT V21, CCITT V23 specification, at an incredible price of £30.

Price is fully inclusive of VAT, postage & packing Send Orders to:

#### **DATA SERVICES**

**EPROM Offer.** 31 Southampton Street, Farnborough, Hants. GU14 6AU Telex: 896559G ECOMS

PARTNO.: 29-1010

# KEN SPEAK

#### WITH THE NEW UNIVOC SPEECH SYNTHESISER

BEFORE YOU BUY A SPEECH SYNTHESISIER JUST COMPARE THE FEATURES OF THE NEW UNIVOC!

\* Allophone-based, UNLIMITED VOCABULARY yet

very simple to program.

\* 256 Programmable levels of speech inflection enable a high degree of speech pitch control.

\* Will operate on any 6502, 6809 and Z80 based based Micro' that allows access to the address, data and control lines.

\* No need to sell when up grading to another micro, just buy another interface cable.

\* Simple to set up, just plugs in to the expansion connector of your micro.

Music and sound effects capability,

\* Built in amp, volume control and speaker with output to audio equipment through 5 pin skt. 
\* Supplied with full instructions and software.

ONLY £79.9

Interface cables for the UNIVOC to suit the following microcomputers:-

BBC £14.95 ORIC £13.95 SPECTRUM £11.95 ACE £11.95 VIC-20 £11.95 ATOM £12.95 More available soon - Specials to order

The UNIVOC is THE only speech synthesiser on the market to offer the user, universal operation, a fully programmable speech pitch control and an unlimited vocabulary.

Add £2 P&P + VAT to price of total order send order with cheque or P.O to: R.P.S ELECTRONICS, DEPT ECM, UNIT C200, SALTAIRE WORKSHOPS, ASHLEY LANE, SHIPLEY, WEST YORKSHIRE, TEL.(0274)588310. Please allow 28 days for delivery.



3024 CS rotterdam - holland tel.: 0031-10 76 63 99 - telex 24392

pieter de hoochstraat 40

# SINGLE CHIP MICROCONTROLLER

Richard Whitlock describes the design of a one chip microcomputer that can be built at a realistic price. Low cost programming hardware and a BASIC cross-assembler all go to make this design the first such controller truly suitable for one off applications.

There are many one-chip microcomputers on the market, all aimed at the "low-end" user, the manufacturer of "smart" toys and games, "intelligent" cookers and washing machines, automobile and industrial control and monitoring systems, and measuring instruments from micrometers to the butcher's scales. Why does Motorola's recent entry to the 8-bit class of this market, the MC6805, warrant more than cursory examination in a magazine such as this, when other devices go largely unnoticed? The answer lies in the fact that, with the introduction of this family of devices, Motorola have opened the door to true one-off, one-chip logic designs at a realistic price.

#### **Masking The Problems**

Previous one-chip microcomputer systems have clearly been aimed at the large volume user, with little or no thought being given to the need of the small volume user. Here the requirements are for a simple to program, cheap to buy, highly versatile circuit element which does not require large expenditure, or heavy commitment to future expenditure, to obtain the modest numbers required. Mask programmed microcomputers can be bought for about the same price as their conventional bus orientated counterparts if sufficient numbers of a single desing are ordered, but mask processing charges are horrific on a

small production run. Admittedly, there have been a number of prototyping systems produced which could physically be fitted into the same socket as a custom programmed, mask-ROM device, but they have generally been too expensive or awkward to program to represent a true one-off or small volume solution.

In some cases all that has been offered has been an in-circuit emulator, a device which interfaces both to the target system and to a host computer from which it receives its program and to which it sends a constant stream of data about its internal states for use in program modification at the design stage. Such systems are clearly useless for anything but developing an application program. A second approach has been to supply a special version of the one-chip microcomputer with no on-board ROM to store the user's program, having instead either additional pins or an integral IC socket, upon which an address and data bus are generated, allowing the connection of a conventional EPROM. Costs have tended to be high due to low volumes sold, since the devices represented little advantage over the three chip minimum systems supported by most microprocessor families without any need to resort to mask programming, (i.e. microprocessor, RAM/I/O/Timer IC and EPROM), and thus did not attract the small volume user to

swell sales. Where a true EPROM based version of the one-chip microcomputer is available it is difficult to program, typically requiring a manufacturer's development system plus a special interface and program (typically several K£!). This again is not an inviting prospect for the small first-time user of a device, and absolutely prohibitive for one-off users such as hobbyists.

#### **Problems Solved**

As can be seen from Table 1, the MC6805 family falls into the third category mentioned above, at first glance, having three true EPROM based versions which cover most of the facilities offered by the remaining mask programmed HMOS versions. However, when it comes to programming, the new Motorola chips are in a class of their own. They program themselves! (No, they don't write their own source code and assemble it. but they do take care of much of the rest of the process). When placed in a very straightforward circuit they program their own EPROM, from a user programmed EPROM, completely automatically. Thus, if the would-be one-chip microcomputer user is already equipped to program a 2532, they can provide themselves with the additional hardware for 68705 programming for well under £5. Well within the reach of the most impecunious hobbyist,

This month and in subsdequent articles we will aim to provide all the information, circuit details and board patterns necessary to start the reader on the way to custom one-chip logic systems, be they stand-alone applications or add-ons for existing computers. A cross-assembler program, written in 8K Microsoft BASIC for easy transportability between machines, is planned and assembly language routines are already written for implementing many standard control and communication functions as well as data gathering and processing operations.

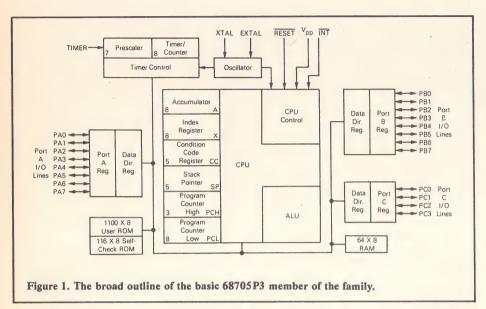
#### Structure And Functioning

Figure 1 shows the borad outlines of the internal structure of the 68705. Fig 2 shows the pin assignments for the device. each of the three variants.

We will first consider the features and functions that are common to all three variants, which are, roughly speaking, those embodied in the 28-pin MC68705P3, and

Features	MC68705P3	MC68705R3	MC68705U3
Technology	HMOS	HMOS	HMOS
Number of Pins	28	40	40
On-Chip RAM (Bytes)	112	112	112
On-Chip User ROM (Bytes)	1.8K EPROM	3.8K EPROM	3.8K EPROM
External Bus	None	None	None
Bidirectional I/O Lines	20	24	24
Unidirectional I/O Lines	None	6 Inputs	8 Inputs
Other I/O Features	Timer	Timer, A/D	Timer
External Interrupt Inputs	1 '	2	2
EPROM Version	_	-	-
STOP and WAIT	No	No	No

Table 1. The 6805 family of devices features three true EPROM versions providing a variety of facilities in either a 28 or 40 package.



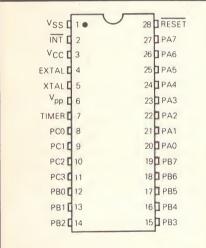


Figure 2. Pin-out of the 68705P3 MCU.

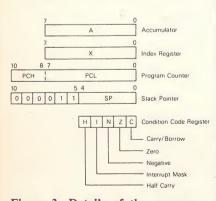


Figure 3. Details of the processor registers. These should look familiar to anyone with experience of either 6800 or 6502 machine code programming.

then move on to the additional capabilities offered by the 40-pin MC68705U3 and MC68705R3.

#### The Processor

Unlike the Intel 8048 or the Zilog Z8, the Motorola 68705's processor is implemented completely separately from the memory and I/O registers, so there is no need for the programmer to keep in mind which bank of RAM registers is currently close-coupled to the Arithmetic and Logic Unit.

The processor registers (see **Fig 3**) are quite conventional in their operation and users with experience of machine code programming on either the 6800 or the 6502 should find little to puzzle them. Details are as follows:-

Accumulator (A) – A general purpose 8-bit register used to hold operands and results of arithmetic and logic operations and other data manipulations.

Index Register (X) – An 8-bit register whose primary function is to hold a value which, when added to a value specified in a program instruction creates an effective address dependant upon past conditions in the system, thus allowing a single programmed routine to cover a number of particular cases. In the 68705s the Index Register can also be used to perform data manipulations using the Read/Modify/Write group of instructions, (see INSTRUCTION SET below).

**Program Counter (PC)** – A register than normally contains the address of the next instruction byte to be fetched and executed. In the 68705P3 which has a total memory space of 2K addresses (2048 locations) the Program Counter is an 11-bit register. In the 68705U3 and 68705R3, which have 4K of

memory space (4096 locations) the Program Counter is a 12-bit register.

Stack Pointer (SP) - A register that contains the address of the next free location on the processor stack. At Processor Reset, or on execution of a Reset Stack Pointer instruction, the Stack Pointer is set to point to the highest RAM address, 07FH. From there it is decremented as data is pushed onto the stack and incremented again as data is pulled off the stack. Only the lower 5 bits of the Stack Pointer are variable, giving a maximum stack depth of 31 locations, i.e. down to address 061 H. The upper bits of the Stack Pointer are permanently set. In the 68705P3 the Stack Pointer is an 11-bit register and in the 68705 U3 and 68705 R3 it is a 12-bit register. The stack area is used during the processing of interrupts and subroutine calls to save the previous contents of all or some of the processor registers. The register contents are pushed onto the stack in the order shown in Fig 4. An interrupt results in all the processor registers, except the Stack Pointer itself, being pushed onto the stack, while a subroutine call results in only the Program Counter being stacked. The maximum depth of 31 locations for the stack restricts subroutine nesting depth to 15 levels if interrupts are not allowed, and less if they are allowed.

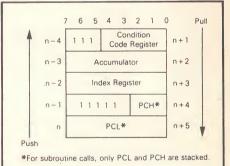


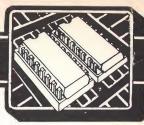
Figure 4. The register contents are pushed onto the stack in the order shown

when an interrupt is detected.

Condition Code Register (CC) – A 5-bit register in which four of the bits are used to indicate significant results of the last instruction executed. The fifth bit is used to control the reception of interrupt requests from other parts of the system. The four result flags can each be tested by program instructions and specific action taken as a result of their state. Each of the five bits is

Half Carry (H) – Set (to logic '1') during addition instructions to indicate that a carry has occurred between bits 3 and 4 of the result. This indication is necessary for arithmetic operations where two BCD digits

explained below.



are encoded within a single byte.

Interrupt (I) – Set at Reset and subsequently cleared (to logic '0') and set under program control, this bit, when set, prevents all interrupt requests from affecting the processor with the exception of the software interrupt instruction, which is executed like any other program instruction. An interrupt request reaching the processor while the Interrupt bit is set is latched until such time as the bit is cleared, when it becomes operative. Negative (N) – When set, this bit indicates that the result of the last arithmetic, logical or data manipulation was negative, i.e. bit 7 of the result was logic '1'.

Zero (Z) – When set, this bit indicates that the result of the last arithmetic, logical or data manipulation was zero, i.e. all bits of the result were logic '0'.

Carry/Borrow (C) – When set, this bit shows that a crry or borrow occurred at bit 7 of the result of the last operation executed. This bit is affected during arithmetic, bit test and branch, shift and rotate operations.

#### The Memory

The memory map of the 2K 68705 variant is shown in Fig 5. The first 16 addresses are more or less fully occupied by the I/O port, control and status registers, depending upon the variant in question. Above these every 68705 has a block of 112 continuous RAM bytes, shared by the user program and the processor's stack, as mentioned above. From address 080H

upwards is the main user EPROM area where the particular application program must be stored. In the 68705P3 this area is 1796 bytes in extent, while in the 68705U3 and 68705R3 it is 3768 bytes in extent. Note that 128 bytes of the user EPROM are within page zero (the area of memory whose addresses can be held in an 8-bit register) and thus, together with all of the RAM and I/O. can be referenced using short form "direct addressing" ("zero-page addressing" in 6502 parlance). Subroutines called from many points in the main program, frequently used data tables etc. can profitably be located in these 128 bytes to take advantage of the shorter and faster instructions capable of reaching them. Above the main user EPROM area is a single location known as the Mask Option Register (MOR). The MOR is again an EPROM register whose contents must be specified by the user. The function of the various bits in the MOR is to carry information used at Reset to configure various parts of the on-chip circuitry.

Greater detail of its operation will be given next month when we discuss the MASK OPTION REGISTER. Above the MOR again is the "bootstrap" ROM containing the self-programming routines which, when activated, enable the 68705 to program its own EPROM from an external user programmed EPROM.

The last 8 bytes of the memory space are again user defined EPROM locations, which must be programmed with the Interrupt and

Reset vectors required for the particular application.

Next month we'll continue the description of the facilities offered by the 68705 but to round off this month we'll whet the appetite by showing just how straightforward it is to program the MPU.

#### Self-Programming Process

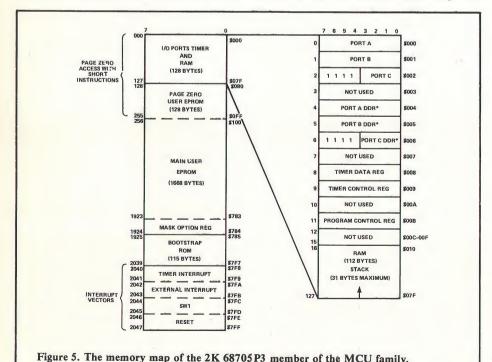
The 68705s have a block of mask programmed ROM containing a "bootstrap" program which is used to program the onboard EPROM with the user's program. At the top of this mask programmed ROM block, immediately below the user defined interrupt service and Reset vectors, is a further vector which is fetched only when the conditions required for programming are all met. The mask programmed contents of these two locations direct the processor to the start of the self-programming routine.

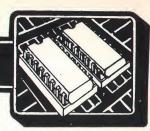
During the execution of this routine the master oscillator is forced into the crystal mode of operation, regardless of the content to be programmed into the CLK bit of the MOR. For the timing of the programming operations to be correct a 1 MHz crystal must be used to regulate the master oscillator.

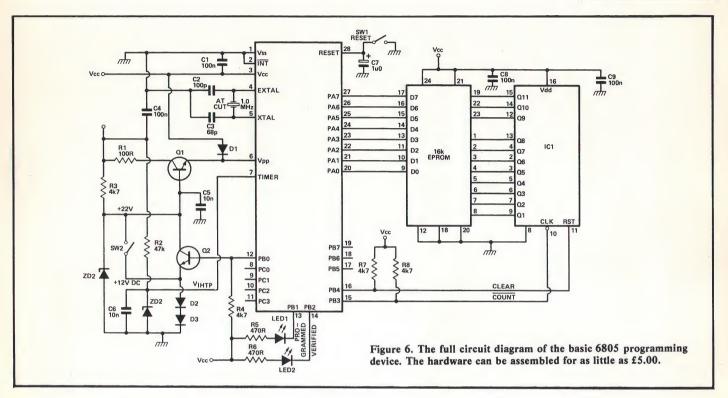
The self-programming routines control the actual programming of the EPROM bit cells by manipulating the least significant two bits of the Programming Control Register at location 00BH. These two bits enable the latching of the data to be programmed onto the outputs of the EPROM block and the generation of the high voltage programming pulses which drive electrons "through" the insulation surrounding the isolated gates of selected transistors within the EPROM bit cells, leaving a semi-permanent charge on the gate and forcing the transistor into a conducting state, thereby pulling the output of the cell up to logic "1" from its unprogrammed logic "0" state.

During normal operation the Programming Control Register is addressable and bit 0 may even be set and cleared by the processor, but it has no effect upon the operation of the EPROM so long as bit 2 is set, and bit 2 is read only, being cleared only by the presence of a high voltage on the  $V_{PP}$  pin, so there is no danger of accidentally entering the self-programming mode from a faulty user program.  $V_{PP}$  is connected to  $V_{CC}$ , the nominal 5 V supply, during normal operation. Fig 6 shows the Motorola recommended circuits for programming both the 2 K and the 4 K memory space versions of the 68705.

Note that the pattern EPROM from which the 68705 programs itself must contain an exact duplicate of the information that is to be programmed into the user EPROM of the 68705. However locations which corres



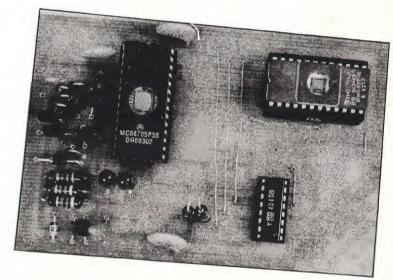




pond to non-EPROM locations in the 68705 are ignored during the self-programming process and can be left unprogrammed. A corollary of this fact is that it is not necessary to use a 2716 to carry the data to be programmed into a 2K memory space 68705, a 2532 with the data located in the lower half will do just as well. A 2532 is used to carry the data for both 2K and 4K versions of the 68705.

The operation of the programming board is quite simple. Before inserting the 68705 and the 2532 into their respective sockets, ensure that switches S1 and S2 are closed and switches S3 and S4 are open. When the ICs are safely socketed, close S4 to apply the 5V supply, close S3 to apply the 26V programming voltage, open S2 to apply the high voltage Program Mode Vector Fetch signal to the TIMER pin, and finally open S1 to remove Reset.

On emerging from the Reset condition the 68705 configures Port B as outputs and then pulses PB4 to reset the 4040 CMOS counter and then clocks it up to a count of 080H (128) by pulsing PB3. The counter outputs are now addressing the data for the lowest user EPROM location in the 68705, stored in the 2532. This data is read in via Port A and latched onto the user EPROM outputs from where it is "burned" into the EPROM cells just like the operation in a normal EPROM programmer. The counter is advanced and the process repeated until all locations up to and including the MOR have



been programmed. Then a further burst of pulses on PB3 step the counter on past the "bootstrap" area to program the last eight bytes, the Interrupt service and Reset vectors. The "Programmed" LED is the lit.

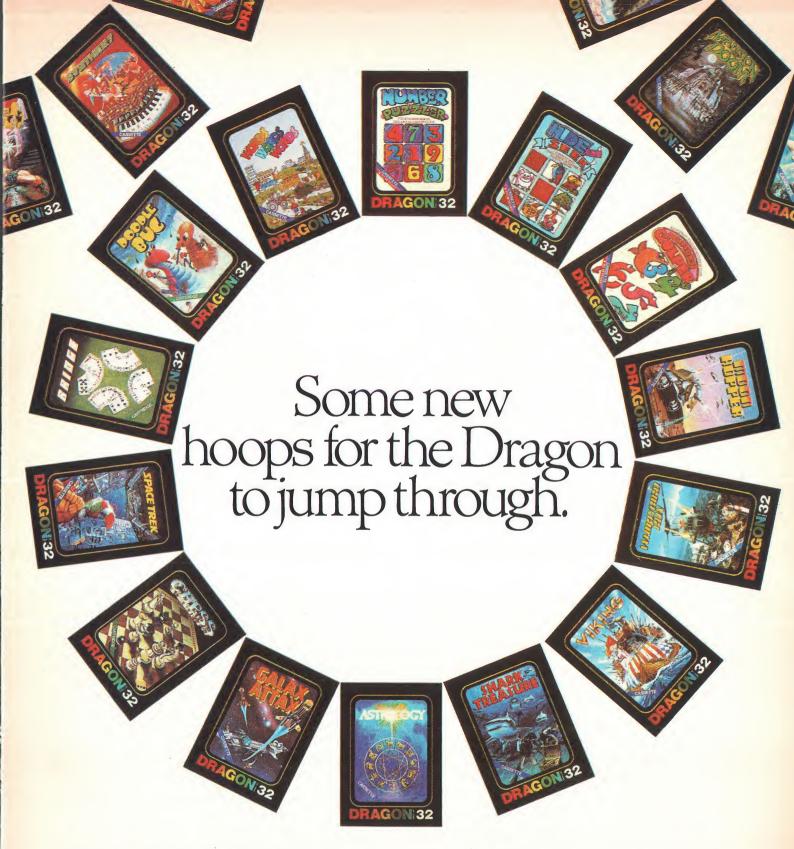
The whole process is then apparently repeated, but in fact a "verify" operation is undertaken, comparing data read from Port A with the newly programmed contents of the user EPROM. If all is well the "Verified" LED will light up and the operation is complete. To power-down the board, before

removing the 68705, first clost switch S2, then S1 and finally open S3 and then S4.

Note that the order of opening and closing switched at the beginning and the end of the programming process is to be strictly adhered to, or the 68705 may be destroyed!

E& CM

Next Month – further details of the 68705's facilities plus construction details of the programming hardware.



Unless you can already write software programs, the usefulness of a home computer is governed, to a great extent, not by its power but by the software available.

After all what's the use of a very large memory if you can't use it properly?

So at Dragon we not only took great care when designing the actual computer, we also made sure that the people who designed the software took equal care.

By using only top writers, and by giving them subjects of interest to you, we

managed to produce some of the very best programs around.

Take, for example, the Cyrus Chess program. Designed by a grand master it, not surprisingly, won the accolade of Microcomputer Chess Champion.

Of course you don't have to be a grand master to play it, but, on level nine, you do need to be one to beat it.

Mind you, that's just one of nearly a hundred Dragon software titles available and, though they're all fun, they're certainly not all games.

There are programs that can teach your children spelling and mathematics.

Another can teach you how to type.

And, although some of our other titles are displayed above, the best way of seeing our full range of software isn't by looking at this ad.

It's by going down to your local Dragon stockist.



#### **INCREASE YOUR FIRE POWER!!!**

There you are, ZAPPING away with your laser, when; suddenly - you're surrounded. Your one chance? a SMART BOMB. You reach for the keyboard - your spaceship nose dives and CRASH!!! - Wiped out. Later, on your cloud, playing your digital harp, you think "If only the SMART BOMB button had been next to the laser on the handset? I'd be alive today". "If only the joystick had sprung back to centre at least I'd be still up there fighting"

NOW! TO SAVE THE WORLD, THE NEW DELTA 14 RANGE OF HANDSETS FROM VOLTMACE



Used for years by DATABASE video game owners these handsets have sprung return, nylon coated steel joysticks with graphite wiper potentiometers for longer life and SMOO-OO-OO-THER control, plus 12 pushbuttons with two extra fire buttons to share the wear.

The DELTA 14 comes in two parts. One handset will plug into the 15 way"D" plug to give analogue joystick plus three button functions. The second part is the DELTA 14B/1 adapter box which plugs onto the 15 way"D" and connects to the user port. This gives use of all 12 buttons on the user port using a 3 x 4 strobed matrix. The eighth line is used to select a second joystick which can be plugged into the adapter box. Suggested software routines included with each handset.

DELTA 14 B JOYSTICK HANDSET FOR BBC	£12.95
DELTA 14 B/1 ADAPTER BOX & CABLE	£13.95



#### **JOYSTICKS from £4.50 each** DIRECT FROM OUR FACTORY

IN KIT FORM: Kit contains 1 switched joystick assembly, 2 moulded case halves, fire button, 1.5 metres 5 core + screen cable, £4.50 per KIT fixing screws READY BUILT with 9 way "D" socket - suit Atari or Vic 20 £5.95 each FEW ONLY with potentiometers and 5 way din socket to suit 

PROGRAMMABLE INTERFACE. Transfers any keys to work on the .....£24.00 above Joystick. Complete with program tape . . . . SAVE £2.45 by buying Interface and Joystick together ... £2' VERSIONS FOR ZX81, SPECTRUM AND JUPITER ACE. £27.50

PLEASE STATE MICRO WHEN ORDERING.

AERIAL SPLITTER SWITCHES ..... £2.50 (Saves unplugging TV Aerial to connect computer)

#### DAZRAM

The entertaining way to learn machine code DAZRAM ADDS COLOUR, SOUND THROUGH TV, SPRUNG RETURN ANALOGUE JOYSTICKS, AND OBJECT ORIENTATED GRAPHICS TO YOUR ZX 81 for only £49.95

By joining it to one of the following computer video games DATABASE, ACETRONIC MPU 1000 & 2000, RADOFIN 1292 & 1392 PRINZTRONIC VC 6000 and IGITERTON VC 4000.

Send stamped addressed envelope for details.

ALSO 26 game cartridges available for the above games including MUNCH & CRUNCH, and LEAPFROG. Note that all the above games except DATABASE will require an adaptor for cartridges or DAZRAM price £4.50 each.

Prices quoted include VAT& p&p, 1 st Class Post, 7 day money back guarantee

Cheques, Postal Orders, Access No. to:

#### **VOLTMACE LIMITED**

Dept. ECM, Park Drive, Baldock, Herts Tel: (0462) 894410 ECM<sub>10</sub>



Callers welcome Monday to Friday. — Trade quantity discounts

#### ANNOUNCING THE QUILL

#### FOR THE 48K SPECTRUM AT £14.95

The Quill is a major new utility written in machine code which allows even the novice programmer to produce high speed machine code adventures of superior quality to many available at the moment without any knowledge of machine code whatsoever.

Using a menu selection system you may create well over 200 locations, describe them and connect routes between them. You may then fill them with objects and problems of your choice. Having tested your adventure you may alter and experiment with any section with the greatest of ease. A part formed adventure may be saved to tape for later completion. When you have done so the Quill will allow you to produce a copy of your adventure which will run independently of the main Quill editor, so that you may give copies away to your friends. The Quill is provided with a detailed tutorial manual which covers every aspect of its use in writing adventures.

It is impossible to describe all the features of this amazing program in such a small space, so we have produced a demonstration cassette which gives further information and an example of its use. This cassette is available at £2.00 and the Quill itself is £14.95.

ALSO NEW FOR THE 48K SPECTRUM

DIAMOND TRAIL ..... £4.95

The latest of our machine code adventures sets you the task of recovering the Sinclive diamond. But first you must overcome many problems in a city fraught with danger and intrigue.

#### GILSOFT

30 Hawthorn Road, Barry, South Glam, CF6 8LE. Tel: (0446) 736369

TELEPHONE YOUR ORDER WITH

BARCLAYCARD VISA



OUR SOFTWARE IS AVAILABLE FROM MANY COMPUTER SHOPS NATIONWIDE, OR DIRECT FROM US BY POST OR PHONE. S.A.E. FOR DETAILS. DEALER ENQUIRIES WELCOME. SOME OF OUR MAIN WHOLESALERS ARE:

UK - PCS Distribution, Darwen, Lancs. Tel: (0254) 691211/2

HOLLAND/BELGIUM - AASHIMA TRADING BY, Hoogstraat 69a, 3011 PH Rotterdam SWEDEN - RIKO DATA, Box 2082, S-230 41 Bara, Sweden

DENMARK - QUALI-SOFT, Vesterbrogade 127 E Mz TV, 1620 Copenhagen V. SOUTH AFRICA - UNIVERSAL SOURCES (PTY) LIMITED, Durban, Natal

#### |G||G||G||G||G||G||G||G

#### BBC FORTH

"For your money you get not only a very good implementation of the popular FORTH language but also a 72 page manual ...Once you have got an idea of the fundamentals you should get better value out of this pack than virtually any other program you could buy. In fact, the only reason I can think of for not buying this cassette is that you already have a version of FORTH!" - LASERBUG April 83

"rqFORTH is fast and has a first-class screen editor . . . Overall, a good buy" - Computing Today July 83

rqFORTH costs just £15 (inclusive) and runs on 16K or 32K BBC micros

- needs no added hardware and works with any MOS version;
- works with cassette and disc; is FORTH-79 STANDARD and has fig-FORTH facilities;
- provides 260 FORTH words and is infinitely extensible; allows full use of the MOS via \*MOS, CALL and EMIT;
- permits use of all graphic modes, even 0-2 (just!); has an excellent full-screen editor;
- runs faster than BBC BASIC;
- includes a 72 page manual, a 20 page disc supplement and a summary card for quick reference
- is used by hundreds of people, worldwide

#### BBC FORTH TOOLK!T

£10

"Level 9 promise to support rqFORTH and this pack proves it. It provides the source code for all sorts of useful routines and examples of how to program in FORTH, With so much on one cassette it would be good value at twice the price." - LASERBUG April 83

The rqFORTH toolkit costs just £10 (inclusive) and adds the following facilities to FORTH:

- a full assembler, providing machine-code within FORTH;
- a full assembler, providing inactime-code within Crim, turtle graphics, giving you easy-to-use colour graphics; decompiler routines, allowing the versatile examination of you compiled FORTH programs
- the full double-number set (with many extensions);
- an example FORTH program and demonstrations of graphics;
- other useful routines.

ECM<sub>10</sub>

ALL PRICES INCLUDE P&P AND VAT. ALL programs are in stock and orders will be sent within 2 days of receipt. Please send order or SAE for catalogue, describing your micro, to:

#### LEVEL 9 COMPUTING

DeptE, 229 Hughenden Road, High Wycombe, Bucks HP13 5PG

#### SOUNDS AND MUSIC **FOR**

#### **ZX81 AND SPECTRUM**

#### THE PETRON TRICHORD

- COMPREHENSIVE MUSIC PROGRAM
- 6,134 × 3 NOTE CHORDS (48K SPECTRUM)
- ORDINARY MUSIC NOTATION USED (A to G)
- RANGE OF MORE THAN 8 OCTAVES
- KEY SIGNATURE APPLIED THROUGHOUT
- **FULL EDIT FACILITIES PROVIDED**
- PRINT OUT MUSIC ON A ZX PRINTER
- NO PROGRAMMING SKILLS REQUIRED
- PRE-PROGRAMMED PROM HAS WIDE RANGE OF SOUND EFFECTS ACCESSED WITH ONLY 2 BASIC INSTRUCTIONS
- DEVELOP AND USE YOUR OWN SOUND EFFECTS

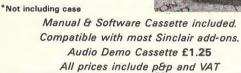
Featured in April/May 1983 ETI magazine

**ZX81** £24.95 **SPECTRUM** £26.95

Kit Prices\*

7X81 £19 95 £21.95

**SPECTRUM** 



PECTRUM

#### PETRON ELECTRONICS

COURTLANDS RD, NEWTON ABBOT, DEVON Tel: (0626) 62836 ECM10



CASSETTE. Operates of 300, 600, 1200 or 2400 Baud. Uses Industry Stondord CUTS at 300 Baud ......

PARALLEL. Two MC 6821 Parallel interface Adoptors. One MC 6848 Programmoble Interface Timer....

ROMA. Uses either 8 × 2708 or 8 × 2716 EPROMS

Disk & Memory Diagnostics.....

**FLEX OPERATING SYSTEM SOFTWARE ON 5"** 

Configurable Flex with Editor & Assembler .... Debug Packoge .... Sort / Merge Packoge .... Disk Utilities ....

lext Processor
68000 Cross Assembler
Relocoling Assembler/Linking Loader
Extended Bosic
Pascal – 6809 Source Compiler
CSC Dynacolic Advanced Spread Sheet
STYLO Stylograph Word Processing

Based around the powerful 8 Bit Motorola MC 6809 processor this High Res. Microcomputer System is available in kit form using  $8^{\prime\prime} \times 8^{\prime\prime}$  boards. It can interface with many perjaherals inc, printers, terminals, monitors & disk drives and is

printers, terminals, monitors & disk drives and is supported with the proven FLEX disk operating software enabling it to be developed into a really powerful Microcomputer system for Business, Engineering, Education or the Hobbylst. Previously known as 77–88 and The ECM HI-RES. Computer Project it has been thoroughly researched and developed in the last 2 years and has been renamed the DENNIS COMPUTER SYSTEM. It is now distributed exclusively by Stirling Microsystems.

RANGE OF BOARDS 6809 CPU. MC 6809 Processor running at 1MHz. EPROM Socket for

84K RAM. Uses 8 × 4164 (64K × 1) memory chips. Extended page facility for 4 boards per system...... £28.75 £125.00

DISK CTRL. Single or Double Density on 5" disks. Single Density only on 8" disks. ... £28.75 £138.00

VDU. 40 Column by 24 Row Text Display ASc11 Encoded Keyboord Input Port 

Sole Distributors: STIRLING MICROSYSTEMS

The National 6809 Centre
241 Baker Street, London NW1. Tel: 01-486 7671
Send for full specification, product details and a free price list. The National 6809 Centre

€6.00 €20.00

£15.00 £50.00

PRICES INC. VAT

.... £15.00 £40.00



#### microcomputer repair service



MC1 Spectrums and Dragons £19.90+£1 p&p

MC2 ZX81 £12.50+£1 p&p

MC3 BBC models A & B Atari models 400 & 800 £24.90+£2 p&p

Commodore VIC20 & C64

No, you're not dreaming! Those are the prices charged by MicroCare for repairing any electronic fault, however serious, in the above computers. They are ££££££'s below the price of Sinclair's repair service, and we give a guarantee! We'll return it promptly, and we'll quality check your unit before it leaves our service centre.

We have the experience it takes. We have the parts on hand. So act now. Let MicroCare get your computer humming again! When sending in your computer, please enclose a brief description of the fault, and make sure that your address is clearly indicated.

> Do not send leads or power plugs. The above prices do not include the servicing of peripherals which will be charged extra.

Personal callers welcome Mon.-Fri. 9.30-5.00 7-9 Thane Works, Thane Villas, London N7 7PH Tel: 01 609 7919

Occupation \_\_\_

Cheques payable to MicroCare.

ECM<sub>2</sub>.

I enclose a cheque or postal order for made
payable/crossed to MicroCare, or I would like to pay by
Access or Barclay Card and I enter my number and
signature accordingly.

Signature \_\_\_ \_\_ Date \_\_

Address\_

MicroCare 7-9 Thane Works, Thane Villas, London N7

ELECTRONICS & COMPUTING MONTHLY-41

PRACTICAL ELECTRONIC

TECHNIQUES A new series that will introduce various aspects of the design and construction of electronic circuitry. This month Brian Lovell sheds light on what to many

people is a black art - the design and production of Printed Circuit Boards.

The prototype unit of many designs will probably consist of a fairly hacked about piece of verboard with a birds nest of untidy wiring between the various components. To transform a circuit in this state into a neat and reliable unit the most effective method is to prepare a printed circuit board layout from the circuit schematic.

What follows is a description of the design and manufacture of PC boards together with a list of suppliers for the materials required in the production of the boards. The initial outlay in equipment is not too great and, with a little practice, anyone following the advice given below should be able to turn out single sided boards quickly and cheaply.

#### Let Us Begin

Bearing in mind that these instructions are for single side boards the following design limits should be noted.

- 1 Have no more than three tracks running underneath an IC.
- 2 Have no tracks running between the pins of an IC except for the ends where 1 holds.
  - 3 Don't take tracks closer than ¼" to the edge of the board.
- 4 The inter-track capacitance must be taken into consideration for high frequency tuning circuits.
- 5 Wire jumpers can be used on the component side of the board if necessary.
- 6 Design the circuit from the component side. All chip pin designations are given in this format. Having two designs, one the mirror image of the other, is bound to cause confusion later on.

Spend plenty of time on this section as mistakes are awkward and time consuming to rectify later on. Start by designing small boards or break a large circuit into small sections (obvious partions include separating the power supply and keeping inputs separate from outputs). This is particularly important when tracking out DC amplifiers. In digital circuits CMOS is relatively immune from noise but don't forget to use 100n tantalum capacitors on V+ near the chips.

#### 1st Stage

Most circuits use ICs these days, the 'legs' being on a 0.1" matrix. It is convenient to design all circuits on such a matrix. Buy an accurate grid (Ambit), 10 lines to the inch. Tape light paper or tracing paper over this grid and reduce your circuit down to the correct size. Use a pencil and have a good rubber ready, the plastic ones are best. Once again take your time and check your work. Space the strips evenly and follow normal design rules.

Sharp corners encourage peeling and hair lines of copper and solder. Large areas of copper have no advantage in low current circuits and can act as a heat sink during the soldering process leading to poor solder connections.

#### 2nd Stage

Preparation of the master. This involves transferring the pencilled pattern onto polyester film using stick on symbols and track. These are high density and jet black for the photographic process later on. Black ink will simply not work. The most well known of these kits is the instant lettering system by Letraset, however they do not reach the requirements for electronics. The best system discovered to date is produced by Alfac. The symbols required are sold in small blister packs of 5 sheets each. These retail at about £2.20 per pack or 40 to 50p per sheet. It is not easy to find but some electronic shops stock it including Ambit. It is best to use a 1 mm track width, any smaller and undercutting can occur during the etching process. A list of the most useful packs is given in Table 1.

E.C. 942 straight track

E.C.953/1 curves, quarter circles

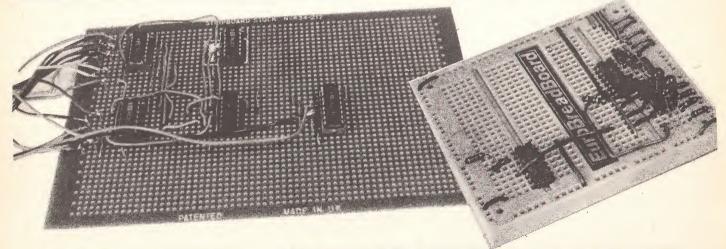
E.C.927/1 T intersections

E.C. 956/1 short bends

E.C. 994/1 chip pads

E.C. 996/1 chip pads

Tracks can also be bought in rolls. They are much thicker than ordinary transfers and unnecessary for general use. If wider tracks are needed they can be built up from the 1 mm strips.



The completed prototype of many designs usually looks something like these projects. Whether some form of solderless system or veroboard is used the finished result is unlikely to look tidy nor to be capable of reliable operation over a period of time.

The base that these transfers are pressed onto must be chosen with care. It must be dimensionally stable, it does not have to be completely transparent since only contact prints are made. Acetate is not suitable since it curls with use and changes shape. Polyester film is ideal (Ambit). An excellent alternative is Selectatrace from Selectasine, one side is rough improving adhesion of the transfers, it can be bought in A1 sized sheets for about £1.20.

Position the polyester above the gride, rough side up and fasten with masking tape to prevent movement. Transfer the pencil pattern to the polyester remembering to preserve correct spacing. A surgeons knife or scalpel is ideal for prising wrongly placed transfers from the polyester. It may help to lightly pencil in the pattern on the polyester first, but as this reduces adhesion it must be done sparingly. A blunt knitting needle is a good tool for applying the transfers, gently at first to prevent cracking and then harder to ensure a firm placing. It helps to do all of this on a clean sheet of cardboard. Despite the small size of the Alfac blister sheets and transfers not in use pick up dirt rendering them useless if care is not taken. Grease on the polyester doesn't help either so keep those hands clean and dry, the fastidious could even use cotton gloves. After completion and checking keep the master in an envelope away from dust.

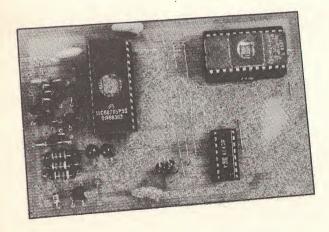
#### 3rd Stage

The master can now be used with pre-coated copper board to prepare the finished design. The technique requires a method for transferring the master pattern to the board. This is done photographically, using Ultra Violet (UV) light. Commercial kits for this task are available but are expensive starting at £35. A cheaper and entirely satisfactory method is to make your own. Use a 300W UV Edison screw bulb, £10 and brass socket which is necessary because of the heat generated: This can be hung above the work using the power cord. Depending on the size of your work, 24" is satisfactory giving an exposure time of about 12 minutes. A sheet of thin glass is also needed to keep the polyester flat. Its UV absorptive properties are allowed for in the exposure time.

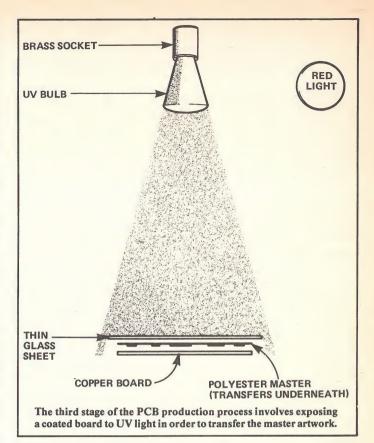
#### Pre-coated Board

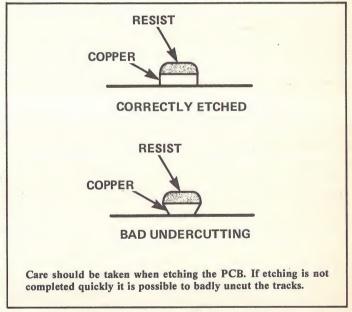
This can be bought from a variety of sources Ambit Maplin etc. Handle as for photographic paper. Use a red darkroom lamp throughout the exposing and developing process. Under the red light carefully peel off the plastic and place centrally, copper side up under the UV lamp. Now place the master, transfer side down on the copper board. Cover with the well cleaned and dust free glass sheet. Expose for approx 12 minutes. Warning, UV light can damage the eyes, wear sunglasses and do not look directly at the bulb. It is better to overexpose than underexpose, trials may be necessary.

When exposed the board is developed in a sodium hydroxide solution at 20°C. A tablespoon of crystals in 500ml of water is about right. A photographic developing tray is handy here, wear plastic gloves because sodium hydroxide is nasty stuff. When, after a few minutes the image appears, wash off in running water delicately removing the unwanted material with your finger. The pattern left is



By designing a PCB for the final circuit a neat and reliable unit can be produced.





an etch resist positive. Unwanted areas of copper are unprotected by the resist. Leave to dry.

#### Etching

A ferric chloride solution is used for this. Dissolve the crystals in warm water. The crystals can be bought from Maplin, various electronic suppliers or in bulk from chemical firms.

To prevent undercutting etching must be done quickly. Flat trays can be used but it is best to force the process. Add a little HCL (Hydrochloric Acid) to the ferric chloride solution. Pour in a large pyres beaker large enough to hold the copper board vertically and heat it up to 40°C. Pump air into the beaker with a fish tank air pump. It is possible to etch in about 2 minutes using this method. Wash in running water and remove the etch resist with screen cleaner or any alkaline solvent.

#### Drilling the Board

Use a high speed drill. A pin vice may be necessary to hold the small bit (£3). 1 mm is ideal for chip legs and general components.

#### Copper Board (Laminate)

Either paper based with a phenolic resin or fibre glass. The former are unsuitable for plated through holes and restricted to single sided PCBs. Fibre glass boards are about 50% more expensive and much stronger. All double sided and multi-layered PCBs are made of this

material. Fibre glass boards cannot be punched and wear out drill bits readily. 1/16" (or 1.6 mm) is the most common thickness for both laminates. 1oz board is quite sufficient for low current use and doubles the life of your etch bath. Both laminates can be sheared using a guillotine, small rake angles (the angle between the two blades) prevent the laminate from splitting (5° to 10°). Alternatively a circular saw or band saw can be used. Fibre glass boards destroy normal cutting edges on both. Bonded diamond cutting edges solves the problem at a price. This plus the problem of fibre glass dust makes shearing the best method. PCB manufacturers will sell in quantity at approx half the price of general electronic suppliers (Oval Products).

#### List Of Suppliers

All of the prices should be checked before ordering.

Oval Products, Benedict road, Mitcham, Surrey, London CR4 3UQ. (01) 648 5913

Pelltech Ltd (Alfac agents)
Station Lane,
Witney,
Oxon OX8 6YS
(0993) 72130
They will give you the address
of the nearest Alfac Stockist

Selectasine, 22 Bulstrode Street, London W1M 5FR (01) 935 0768

Sericol Group Ltd., 24 Parsons Green Lane, London SW6 4HT (01) 736 3388

Taylor V. M. Electrical Ltd., High Holburn (near Chancery Lane tube) (01) 405 0042 Stock Edison screw brass sockets. Wholesale Fittings, 13 Berners Street, London W1P 4BY (01) 637 5393 Stock UV lamps, Edison screw 300W.

Ambit International, 200 North Service road, Brentwood, Essex CM14 4SG (0277) 230 909

R.S. Components
(Wholesale and account holders only)
Enquiries (01) 250 4000

#### E&CM PCB SERVICE

This month we expand the *E&CM* PCB service to include the boards presented in this issue. Each month we produce high quality boards to support the projects featured in *E&CM*. The prices shown include VAT but a 45p post and packing charge must be added to the cost of the board(s) ordered.

CM PCB SERVICE... E&CM PCB SERVICE... E&CM PCB SERVICE... E&CM PCB SE

April 1983 TV to RGB Conversion £2.70 July 1983 Power Control For Micros	HOW TO ORDER List the boards required and add 45p post and packing charge to the total cost of the boards. Send your order with a cheque or postal order to:
Relay Board £2.02 DAC Board £1.77 Stepper Motor Driver £1.59 BBC Sequencer Interface £2.10	ECM PCB Service, 155 Farringdon Road, London EC1R 3AD.
August 1983 Oric Output Port £2.10 Spectrum Sound Board £2.20	Please supply the following PCBs:
September 1983           BBC Darkroom Timer         £1.15           Cassette Signal Conditioner         £1.23           ZX81 Sound Board         £3.77           October 1983	Post & Packing 45p           TOTAL £            Name         (please print)
Spectrum Effects Box         £1.71           Oric Via         £3.37           BBC EPROM Programmer         £5.12	Address

#### GO FORTH & ★;

#### FASTER DEVELOPMENT – FASTER PROGRAMS – FASTER ACTION

FURTH Tapes	
BBC A/B with editor, assembler, graphics, too	lkit £25
Dragon 32 with access to graphics	£18.95
Spectrum 48K with colour and sound	£14.95
Nascom 2 under NAS-SYS 3	£22.50

FORTH is available on disc, cartridge, or cassette for most machines inc. CP/M, IBM, Sirius, FLEX...

DIY FORTH Kits		
Installation Manual	£7	
How to do it + model + definitions + editor		
Source code listing for one processor	£7	
6502, 6800, 6809, 8080, Z80, 8086/8088, 996		
1802, 68000, Z8000, VAX, Apple ][, LSI-11, Eclip	ose	

FORTH Books – range includes:	
'Starting FORTH' by Brodie	£16
'Systems Guide to fig-FORTH' by Ting	£26

JUPITER ACE—a very nice FORTH micro . . . . £89.95

All prices include VAT and p&p ECM10



MicroProcessor Engineering Ltd 21 Hanley Road Shirley Southampton SO1 5AP Tel: 0703 775482

#### NEW FOR YOUR 48K SPECTRUM HIDDEN CITY £5.95

Fly your ship to the cave avoiding the robot gun and ground bases. Enter the maze and steal the fuel. Fly through the cavern avoiding ground based missiles and floating mines. Find the HIDDEN CITY and position yourself to fire a missile into the heart of the City and at the same time fly on to safety. It's a tough assignment but YOU can do it. Joystick or keyboard control (Kempston Joystick).

#### SOUND BOOSTER FOR YOUR SPECTRUM

Fed up with straining your ears? Then this little beauty will give you superb sound. Just plugs into your Spectrum. No need to open the case. No batteries required. Super clear and sharp sound from your favourite games. Volume control.

**ONLY £8.95** (+ 50p p&p)

Competition-Pro Joystick
ONLY £24.75 (+ 50p p&p)
Interface alone £15.00 (+ 50p p&p)

Vic 20 Joystick - CBM 64 Joystick -Atari 400/800 Joystick **ONLY £13.50** 

If you want to use your Kempston type joystick with lots more games then you need ...

SOFTLINK 1 and SOFTCON 1
Details on receipt of s.a.e.

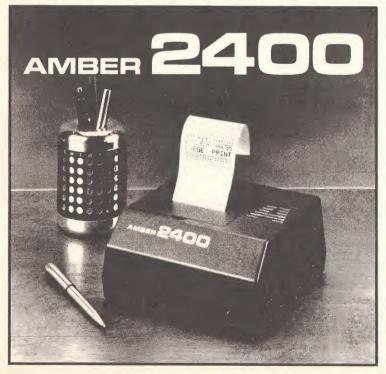
Dealer enquiries welcome re:- HIDDEN CITY and SOUND BOOSTER. very generous discounts.

Cheques/POs to:-

#### BYTEWELL

203 Court Road, Barry, S. Glam. CF6 7EW Telephone: (0446) 742491

# PRINT OUT



#### AMBER 2400

LOW RUNNING COST USING
PLAIN PAPER
USED WITH MANY COMPUTERS
INCLUDING BBC, UK101, ATOM
DRAGON, NEWBRAIN, ATARI,

£ 78

+VAT & £2.95 P&P Or for details send a large SAE to:

#### LETHABY NUMBERING SYSTEMS LTD.

Central Way
Walworth Industrial Estate
Andover
Hampshire SP10 5AL

#### COMPUSENSE

#### **SOFTWARE AND HARDWARE FOR THE 6809**



Dept. ECM, PO BOX 169, PALMERS GREEN, LONDON N13 5XA Telephone: 01-882 0681 (24 Hr) and 01-882 6936 Offices at 286D Green Lanes (9.45-6.00 Mon-Fri)



**SPECIAL OFFER** while stocks last **SS-50 CHASSIS KIT:** original SWTPc 6800 chassis includes MP-B2 mother board with all components and 10 Amp power supply. Complete casing with cutouts for terminal/printer connectors. Originally sold for use with 6800. Simple modification to motherboard (or use the DS68 motherboard) to use 6809 and FLEX-9. Supports up to **One Megabyte** of RAM using suitable CPU card.

ONLY £65.95 plus £4.00 carriage Also available built for £150.00

To build a complete system to run FLEX-9 you need in addition to the chassis: a CPU card, RAM (56K recommended), disk controller and serial interface plus disks and terminal.

#### for FLEX-9 £150.00 OS-9 (Level 1 and 2) £240.00 UNIFLEX £360.00

#### 6809 SOFTWARE

#### SP09-16 FLEX General ..... £130 6809 FLEX SWTPC ... £130 SP09-1S SP09-2 6809 Editor . . . . . . £45 SP09-3 6809 Assembler ..... £45 SP09-5 6809 Debug Package ... £65 SP09-6 6809 XBASIC ..... £90 6809 Precompiler . . . . £45 SP09-8 6809 Sort/Merge ..... £65 SP09-10 6809 Utility ..... £65 SP09-11 6809 Disk Repair . . . . £65 SP09-12 6809 Text Processor . . . £65 SP09-13 SP09-15 6809 PASCAL ..... £175 Stylograph ..... £185 STYL0 SW012 XDC/XCRF ..... £25 SWTPFLEX SWTPC FLEX ...... £85 RMS(FLEX) . . . . . £175 WC001 RMS(059) . . . . . £215 WC001 WC001 RMS(UNIFLEX) .... £260 Super Sleuth ..... £85 CSC001 Super Sleuth 80 . . . . . £85 CSC002 CSC003 Cross Assembler Macro Sets ..... £45 Tabula Rasa ..... £100 CS006 CS009 6805 Simulator . . . . . £85 6502 Simulator . . . . . £85 CS010 CS011 6502 Translator ..... £85 CS012 6800 Translator ..... £85 CS013 6809 Pic Xlator ..... £85 Strumacs . . . . . . . . . £25 CSD001 CSD008 Dynacalc (FLEX) ..... £150 Dynacalc (059) ..... £240 CSD008 Dynacalc (Uniflex) ... £345 CSD008 CSD010 Dynamite+(FLEX) .... £90 CSD010 Dynamite+(059) .... £170 COBOL ..... £250 CSD011

#### Postage £1 per item maximum £2.50

#### HARDWARE Bare PCBs for \$\$50/\$\$30

CSH00	SWTPC Motherboard PCB. £20
CSH00	
CSH00	5 SWTCP Parallel Interface £10
CSH00	
CSH00	S SWTPC DC2 Disk Controller £20
CSH009	9 F&D 6800-6809 Converter £15
CSH01	DR 16K RAM PCB (2114) £35
CSH012	2 DR 64K RAM PCB (6116) £50
CSH013	F&D Disk Controller PCB £35
CSH014	4 SWTPC 8K RAM PCB (4044) £15
CSH01	DSD 16K RAM PCB (2114) £25
CSH01	
CSH01	7 DS6B6809 CPU PCB <b>£38.90</b>
CSH018	B DS68 5" Disk DSSD PCB <b>£38.90</b>
CSH019	9 DS68 Dual Serial Port PCB £25
CSH02	
CSH02	
CSH02	
CSH02	
CSH024	4 SWTPC Chassis Ass £150
CSH02	
CSH027	
CSH028	
CSH029	
CSH030	
CSH03	
CSH032	2 DS68 Multiple I/O PCB <b>£38.90</b>

#### **Kits/Assembled PCB**

DC2	SWTPC 5" Disk Controller	083
MP-8	SWTPC 8K RAM	£95
MP-LA	SWTPC Twin Parallel Port	£40
MP-S	SWTPC Serial Port	£40
MP-SKIT	SWTPC Serial Port Kit	£25

Postage £1 per item maximum £2.50

All prices exclude VAT.

Please add 15% on total including Postage.

#### **DRAGON SOFTWARE**

DASM £16.48
DEMON £16.48
DECODE £16.48
HIRES £22.00
EDIT+ £30.00
SPACE RACE (Cartridge) £16.48
DEMON/DASM £26.48
SPACE RACE (Cassette) £6.91
PIRATES AHOY (Cassette) £6.91
C-TREK (Cassette)
DESERT GOLF (Cassette) £6.91
POKER (Cassette) £6.91
DISASSEMBLER (Cassette) £5.20
THE GAME OF LIFE (Cassette) £5.20
Please add 42p postage

#### **BOOKS NOW IN STOCK**

The Working Dragon 32 £5.95			
Programming the 6809 (Zaks) £12.50			
Enter the Dragon £5.95			
The MC6809 Cookbook (Warren) £6.25			
Postage on books add 50p per book -			
maximum charge £1.00 Zaks £1.00 p&p			
No VAT on Books			

#### COMPONENTS

	1	10	100
8833	Quad Tristate Buffer 2.40	2.30	_
8835	Quad Tristate Buffer 2.40	2.30	-
6116	2K Static Ram 4.95	4.40	3.95
2732	4 K EPROM <b>3.50</b>	3.20	2.99
2764	8K EPROM <b>5.00</b>	4.80	4.50

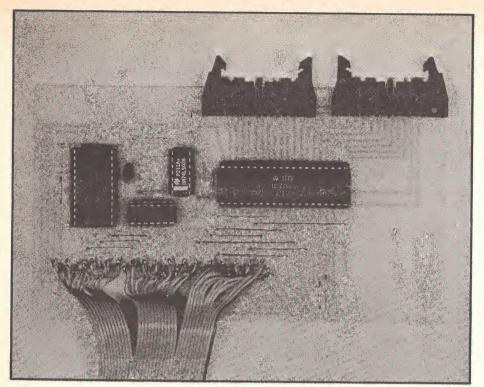
Please add 10% for postage minimum 50p – maximum £3.50

51/4" Diskettes 10 for £17.95 inc. VAT & postage

Dragon Dust Cover £2.99 inc. VAT& post

Fast Mail Order Service – Export Orders Welcome

Send Large SAE for Catalogues (SS50/6809 and/or Dragon)



#### ORIC 6522 IN/OUT PORT

Robert Penfolds describes a sophisticated input/output port for the Oric computer.

In common with other low cost microcomputers the Oric 1 has only a limited range of built-in interfaces, and does not feature a port which can be used directly as a latched output to drive LEDs, relays etc., or as an input for switches or analogue to digital converters. It is possible to add a latch to the parallel printer port for simple output applications, as described in an earlier article in E& CM, but for more demanding applications a PIA or VIA can be added to the expansion port.

The latter has the full complement of address, data, and control bus lines, and it would presumably be possible to add any of the normal 6800/6502 family of interface devices here. The 6522 was chosen as it is relatively straightforward to use even if only one or two input or output ports are all that is required. In addition it has a number of features which ultimately make the device more versatile than alternatives such as the 6821.

The device provides two 8 bit input/output ports which have each bit individually programmable as an input or an output. Additionally, each port has two handshake lines, one of which can be used as in input or an output, and one which is an input only.

The device also has two 16 bit counter/timers, and it provides the opportunity to use interrupts. In both cases these facilities have not been tried in earnest by the author, but there is no obvious reason why they should not be usable in specialised applications which require their use. They can only be

employed in conjunction with machine code routines however and their use requires an indepth understanding of both the Oric and the 6522. In this article we will only consider the use of the interface as an input/output port.

#### Using The Ports

All the registers of the 6522 together with their addresses are shown in **Table 1**, but only the first four are used when using the interface as simple input/output ports.

An interesting feature is the inclusion of two registers for Port A, one which gives operation of the handshake lines (if they are used), and one which does not. In practice Port A would normally be addressed at BFF1 whether handshaking was required or not. The point about register BFFF is that it gives the option of using Port A without activating the handshake lines and at the same time using this port with handshaking via BFF0. This is not something that is likely to be used a great deal in practice, and we will assume here that Port A is always accessed via BFF1.

Before a Port can be used it is necessary to set up each data line as an input or an output. as required. This is where the Data Direction Registers (DDRs) at BFF2 and BFF3 are used. Setting a bit of these registers at 1 sets its corresponding data line as an output, while setting a bit at 0 makes the relevant data line an input. For instance, at switch-on the DDRs are both set to zero and all the data lines are inputs, but if 240 (11110000 in binary) is sent to DDRA at BFF3, PA4 to PA7 are set as outputs while PA0 to PA3 are left as inputs. In most cases all lines of a port will be set as inputs or outputs, and it is then just a matter of writing 255 to the appropriate DDR if an output port is required, or, alternatively, writing 0 to the DDR to ensure that all lines have been properly set as inputs.

In general there is not likely to be any difficulty in driving opto-isolators, logic ICs, relay drivers, and so on from either port, or in driving the ports from logic ICs, A/D

... Turn to Page 50

_				
	HEX	DECIMAL	REGISTER	
	BFF0	49136	Port B	
	BFF1	49137	Port A (handshake)	
	BFF2	49138	Data Direction Register B	
	BFF3	49139	Data Direction Register A	
	BFF4	49140	Timer 1 Counter (low byte)	
	BFF5	49141	Timer 1 Counter (high byte)	
	BFF5	49142	Timer 1 Latch (low byte)	
	BFF6	49143	Timer 1 Latch (low byte)	
	BFF8	49144	Timer 2 Counter (low byte)	
	BFF9	49145	Timer 2 Counter (high byte)	
	BFFA	49146	Serial Shift Register	
	BFFB	49147	Auxiliary Control Register	
	BFFC	49148	Peripheral Control Register	
	BFFD	49149	Interrupt Flag Register	
	BFFE	49150	Interrupt Enable Register	
	BFFF	49150	Port A (no handshake)	
	Table 1. 6522 registers together with associated addresses.			

# The Circuit

Fig 1 shows the full circuit diagram of the Apart from the 6522 itself the only other circuitry required is the address decoding.

would presumably be some 32K of memory address range of the 6502 occupied by from address #BFE0 to #BFFF (the # sign map (Appendix A) in the Oric manual. The point that has to be kept in mind is that theless RAM and possibly ROM located With the 16K version of the Oric there locations free of RAM or ROM, but the 48K version of the machine has the full 64K RAM (16K of which is overlaid by ROM). However, there are spare memory locations being used to indicate a hexadecimal number in Oric BASIC), as shown in the memory although these addresses are normally unused by the machine, there are never-

situation is different, as there would be two devices placing an output on the data bus if RAM and the output device. When both the RAM and input circuit were read When using the expansion port of the Oric as an output this does not matter since the microprocessor will simply write to both the information is being read from the port the simultaneously.

corruption of the data. Experimentally taking internal input/output devices can be cut off from the data bus, but the list of terminals Appendix F) in the manual does show one input which is normally high, and taking this pin low when inputting data appeared to be partially effective, but still left some allowed an unhindered flow of data onto the The Oric manual does not specify how the marked I/O control. This appears to be an the ROMDIS and MAP pins low as well seemed to entirely clear the problem, and data bus.

In the circuit of Fig 1 IC1 is a 4 to 16 line decoder, and the only output which is used in this case is output 11 (B in hex). This is used to decode the upper four address lines. IC3 is an eight input NAND gate which is used to decode the middle eight address lines, and will only produce a low output if all eight

inputs are high (FF in hex). Two NOR gates of IC2 are used to produce a low output only when the outputs of IC1 and IC3 are both low, which only occurs when addresses

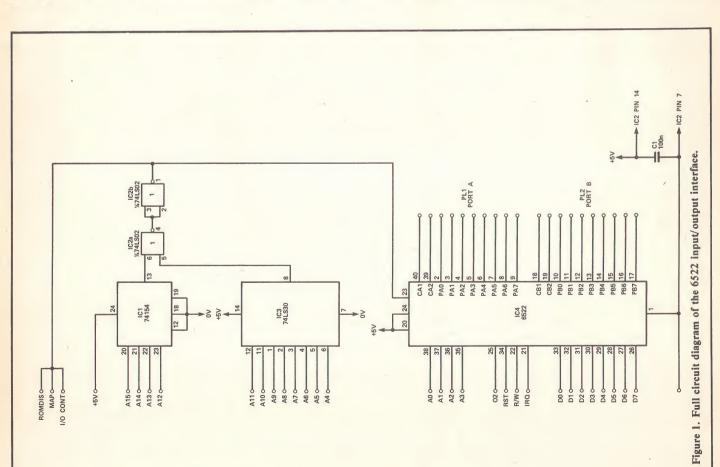
address lines and the 6522 therefore drive the negative chip select input of the address decoding so that the addresses from rom #BFF0 to #BFFF are present on the address bus. The output from IC2b is used to 6522 (IC4), and the positive chip select input The 6522 has sixteen internal registers which are selected using the register select inputs. These are fed from the lower four occupies all the address locations from #BFF0 to #BFFF. There is effectively full #BFE0 to #BFEF are free for use with is simply wired to the positive supply rail. other interfaces.

The eight line data bus connects direct to the Oric uses the 1.5 MHz 6502A version of a buffer here, but it seemed to be superfluous The clock input of the 6522 is fed from the and an important point to note here is that the high speed 6522A device for IC4, and the the bidirectional data bus of the 6522. A 74LS245 transceiver was originally used as clock frequency is just 1MHz even though the 6502. It is thus unnecessary to use the and has been omitted from the final design. clock (02) terminal of the expansion port, standard 6522 is perfectly satisfactory.

ponding lines of the Oric expansion port. The The reset, read/write, and IRQ (interrupt request) terminals connect to the corres-6522 is therefore reset at switch-on and when the break switch is operated.

power supply via the two output terminals of the expansion port. The power supply seems supply if it is likely to be used for prolonged periods. The supply current required is about The circuit is powered from the Oric and medium term, but it might be advisable to supply the interface from its own power well able to take the extra load in the short 100 milliamps or so. C1 is merely a supply decoupling capacitor.

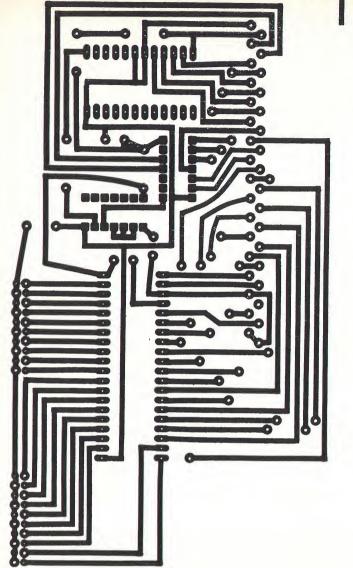
Note that two gates of IC2 are unused and that no connections are made to the inputs or outputs of either of these.



Units of this type tend to be a little awkward from the constructional point of view, but the single-sided printed circuit board of Fig 2 is reasonably straightforward to build and there is little risk of errors being made when using this method of construction. The board will probably be most easy to build if the link wires are added before the integrated circuits and C1 are soldered in place. On the prototype all four integrated circuits are mounted in sockets, and it is strongly recommended that at least IC4 should be fitted in one.

The connection from the board to the Oric is made by way of a 34 way ribbon cable of up to about one metre in length fitted with a 34 way header socker, and ready-made cables of this type are easily obtained. The header socket plugs into the expansion port of the Oric, while the free end of the cable connects to Verpins fitted at the appropriate points on the printed circuit board. Connecting the cable is quite easy provided you strip the insulation from the end of each wire and tin the exposed wire, plus the veropins, with a generous amount of solder. Be careful not to

Figure 2. (right) shows the foil pattern of the PCB.
This has been designed as a single sided board in order to keep costs down.



cross over any of the leads and to connect the cable the right way round (refer to Fig 2 and Appendix F of the Oric manual).

Figure 4. The overlay of the project. It is strongly recommended that IC4 is mounted in a socket. There are a number of links on the board and these are best formed before any

other components are fitted.

The input/output connections of the 6522 are taken to two 20 way IDC plugs, and in each case ten pins are used as ground connections and screens while the other ten carry the eight input/output connections plus the two handshake lines. The pin configurations of the two connectors are slightly different to keep the printed circuit board as uncomplicated as possible) and the two configurations are shown in Fig 3. The ports are designated Port A and Port B to correspond to the method of identification used in the 6522 data sheet.

## Testing

Connect the interface to the expansion port of the Oric before switching on, so that the 6522 is reset at switch on. A quick initial check of the unit can be made by typing into the computer.

PRINT PEEK (#BFF0)

rectified.

0

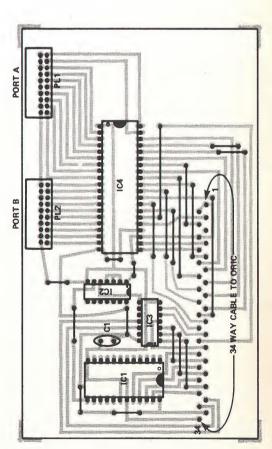
0000000

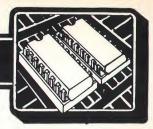
Figure 3. The pin configurations of the two PCB connectors.

ALL CONNECT TO GROUND

0 0 0

all eight data inputs. Port B is a #BFFO incidentally. If the unit is not operating properly some other answer will be obtained, and this would probably by 85 which is the number normally programmed into #BFFO and other unused memory locations of the Oric after switch-on. If the right answer is not obtained switch off at once and check the unit thoroughly until the fault is found and





converters etc., but the 6522 data sheet should be consulted if there is any doubt as to whether or not a particular device will directly interface to the unit. The data sheet gives a mass of information about voltage levels, drive currents, etc.

#### Handshaking

Some applications will need no more than the eight input/output lines of each port, but it will often be necessary to additionally use one or both of the handshake lines. The form which the handshaking takes will vary from one application to another and in its most simple form it is just a matter of producing an output pulse to indicate to the peripheral device that new data is available, or of acting on an input pulse which signals to the computer that new data is present at the input. A more sophisticated technique may be required in some cases where, for example, it might be necessary for a peripheral device to indicate that it is ready to receive data, with the computer then sending data to the port and indicating that it has done so. This requires two handshake lines, one acting as an input and the other operating as an output.

The 6522 can handle any normal handshaking requirements, and the handshake lines are not difficult to master.

The handshake lines are made to operate in the required mode by writing the appropriate number to the peripheral control register at BFFC. When a handshake line is used as an input, a bit of the interrupt flag register at BFFD shows whether or not the input has been activated.

If we consider the peripheral control register first, bits 0 to 3 control the Port A handshake lines while bits 4 to 7 function in exactly the same way but for Port B. In order to illustrate the way in which the handshake lines are controlled we will only consider the use of Port A together with bits 0 to 3 of the peripheral control register.

CA1 can only be used as in input and it has just two modes of operation. If bit 0 of the peripheral control register is set at 0 a high to low transition of CA1 sets its interrupt flag, while a 1 in bit 0 of the control register results in the flag being set on a low to high transition of CA1. There are two ways of resetting the interrupt flag to zero, and one of these is to simply to perform a read or write operation to Port A at BFF1. The other is to write a 1 to the appropriate bit of the interrupt flag register (it cannot be set at 0 by writing 0 to this bit of the flag register).

CA2 can be used in four input and four output modes, and it is controlled by bits 1 to 3 of the peripheral control register. Table 2 shows the available modes and the binary codes/decimal numbers that produce them.

Control Register	Mode of Operation
000/0	Handshake Input Mode (high/low)
001/2	Independent Input Mode (high/low)
010/4	Handshake Input Mode (low/high)
011/6	Independent Input Mode (low/high)
100/8	Handshake Output Mode (high/low)
101/10	Pulse Output Mode (high/low)
110/12	Low Output Mode
111/14	High Output Mode
Table 2. The available modes of	CA2 together with the binary codes to produce them.

The handshake input modes are the same modes that CA1 uses. The independent mode is different in that read and write operations to Port A do not reset the interrupt flag, and the only way of doing this is to write a 1 to the flag. In the handshake output mode CA1 is taken low by a write operation to Port A at BFF0, and is reset to the high state by an input to CA1. In the pulse mode it goes low for one clock cycle (about 1 us) when data is sent to Port A at BFF0. In the low and high output modes CA2 simply stays continuously in the specified state.

Thus, to set CA2 in the handshake output mode and CA1 in the low to high mode the number written to the peripheral control register would be 9(8+1) using the command:-

#### POKE #BFFC,9

Of course, this sets the control register for Port B at zero, and if this port was in use as well the number POKEd would have to be calculated to set the upper four bits in the correct states as well.

Four bits of the interrupt flag register are used in conjuction with the handshake lines. as detailed below.

> Bit 0 (1 in decimal) CA2 Bit 1 (2 in decimal) CA1 Bit 3 (8 in decimal) CB2 Bit 4 (16 in decimal) CB1

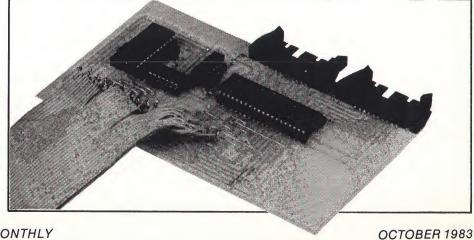
In order to check if just one bit of the register has been set the logic AND function

is used. For example, PRINT PEEK (-(#BFFD) AND 8 would give an answer of 8 if bit 3 of the interrupt flag register is set, or 0 if it is not. In other words the other bits are masked off and do not affect the number returned. This system can be used with any of the other bits of the register, but be careful to AND the PEEKed value with the correct number.

Apart from the two ports and the two timer/counters the 6522 also has a serial register, and input latches on both ports. There is not enough space to go into greater detail here, and anyone using the interface would be well advised to obtain and carefully study the 6522 data sheet.

PARTS LIST
------------

PARTS LIST	
Capacitor C1	100n
Semiconductors IC1 IC2 IC3 IC4	74LS154 or 74154 74LS02 74LS30 6522
Connectors PL1, 2	20 way IDC plugs
Miscellaneous PCB, Veropins, 34 fitted with 34 way I DIL sockets, Wire,	DC header socket,



#### Interak 1

#### WHAT USE IS A COMPUTER?

What use is a computer if you don't know how it works? The only way to find out how computers really work is to build one yourself. You might think it is impossible to build a computer which will compare with today's modern plastic 4-chip wonders – where could you buy the plastic case, the mask programmed ROMs, the special ULA chips? Well true enough, you can't build a computer like that yourself, but who cares, you don't have to – you can buy one at any newsagents for £39.95 or so.

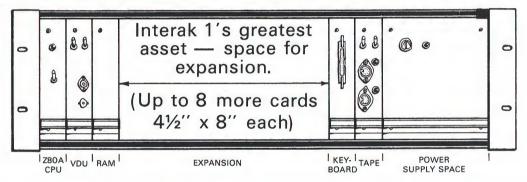
No, what we're suggesting is to build a computer the "traditional" way, using ordinary readily available parts. A Z80A 4MHz CPU of course, and plenty of RAM (starting at address 0000, so that if you want you can get to floppy disks and CP/M one day), but in the main using ordinary 74LS-series TTL Build it in a standard 19" x 3U professional rack, use gold-plated edge connectors, a decent power supply and keyboard and it will last for years.

You may be surprised to see the phrase "it will last for years" in connection with a computer, but pause and think a

while. Why shouldn't it last for years? Why has the computer buying public been conditioned to expect the lifetime of a computer to be measured in months? You don't expect to throw away a hi-fi, TV, or video recorder before the guarantee is hardly expired, so why put up with built-in obsolescence in a computer?

Mind you many people are very silly when it comes to buying a computer — like lambs for the slaughter, they play right into the big manufacturer's hands. He knows they'll all simply be asking for how many "K" they get to the pound, how many cassettes or cartridges are available with innumerable permutations of blob dodging games, and so on. Nobody seems to ask how long will it last, can he fix it himself if it goes wrong, can he have a circuit diagram and technical manual, will he get help if he's in trouble?

The secret of the Interak 1's success in overcoming the built-in obsolescence is that it is based on plug-in cards. Any part that gets so old fashioned that it has to be thrown away will involve the sacrifice of only that card—the whole



computer doesn't have to be scrapped, and the components on the card can all be salvaged. Any new development which could not have been forseen years ago can easily be added at a very late stage simply by adding another card.

A couple of examples will make this point: There is a popular computer which has been out for a couple of years, which claimed to have everything when it was first introduced - every conceivable interface was included. But not quite everything . . . they didn't include a real-time clock. Of course one can be cobbled on via a piece of ribbon cable dangling round the back, but should such a device be added to Interak, the card will fit neatly in an empty slot and look to all the world as though it was designed in from the outset. The next example, from the same computer, is the unfortunate fact that its designers backed a loser - for its floppy disk interface they chose a controller chip which became virtually obsolete, and many of their users are now suffering severe delays if they want to upgrade to disks. Such a thing wouldn't happen to Interak; if such a component became permanently difficult to purchase it would be a simple matter to design a new card using some other more suitable chip – nobody would be marooned with needing an impossible upgrade.

If there is any chance at all that you might be interested in reading more about Interak and what it is all about, we urge you to send or telephone for a free 40 page type-written description specification etc. (a 21 p stamp, and a large self-addressed envelope helps save us money and time, but is by no means essential). Prices of the first few cards, components and manuals are given below, so that you can get some idea of the cost.

Far from keeping the circuit diagrams and descriptions secret we actively encourage you to purchase one or more Manuals in advance—it is only a few pounds, and if it saves you wasting hundreds in buying something unsuitable it will be money well spent. If you have difficulty getting details like this from a computer manufacturer just imagine what problems you'll face if you buy his computer and later need service.

	"Bare Board"	"Manual"	"Parts"
VDU Interface	£16.95	£2.00	£27.29
Backboard	£12.75	£1.00	To Choice
CPU Card	£10.95	£1.50	£13.41
16K Dynamic RAM	£10.95	£0.75	£13.63
Keyboard Int.	£15.95	£2.00	£ 9.81
Cassette Int.	£16.95	£2.50	£19.88
	Backboard CPU Card 16K Dynamic RAM Keyboard Int.	VDU Interface         £16.95           Backboard         £12.75           CPU Card         £10.95           16K Dynamic RAM         £10.95           Keyboard Int.         £15.95	VDU Interface         £16.95         £2.00           Backboard         £12.75         £1.00           CPU Card         £10.95         £1.50           16K Dynamic RAM         £10.95         £0.75           Keyboard Int.         £15.95         £2.00

Please add 50p handling charge to all orders, then add 15% VAT, (except that the manuals are rated at 0% VAT). Make cheques, postal orders etc. payable to GREENBANK ELECTRONICS, and cross them. Polytechnics, Universities, Government Departments etc. can also telephone their orders for immediate despatch on 30 day account. ACCESS and VISA (BARCLAYCARD) orders are welcomed, written or telephoned.

Try your local INTERAK Dealer:

MK ELECTRONICS

98a Watling Street, Towcester,
Northants NN12 7DA

Telephone: (0327) 50292

#### Greenbank

Greenbank Electronics (Dept. C10E), 92 New Chester Road, New Ferry, Wirral, Merseyside L62 5AG. Tel: 051-645 3391.

Conductor 32 The complete speech synthesis system

#### SPEECH SYNTHESIS MODULE for the Dragon 32 Computer -

- Fully-cased module plugs into cartridge port.
- Unlimited vocabulary; based on SP0256 allophone speech
- Over 200 words and all numbers pre-defined for access by entering word or number required.
- Complete control using 5 new BASIC commands
- Speech can easily be incorporated into existing BASIC
- Up to 40 words spoken from one command; speech can occur simultaneously with graphics.

Also available: SOUND EXTENSION MODULE for use with Dragon 32 Computer - provides facility to play chords - easy to use via BASIC - built-in sound effects - music and graphics can occur together without loss of speed based on AY-3-8910, includes two I/O ports - ONLY £34.95 inclusive.



/Cheque/P.O. to:-

#### J.C.B.(MICROSYSTEMS)

29 Southbourne Road, Bournemouth BH6 5AE Telephone: (0202) 423973

Write or phone for further details

ECM10

#### FOR THE **BBC MICROCOMPUTER**

PASCAL-T is a 16K Eprom program capable of compiling source PASCAL into a compact very fast threaded-interpreters-code. Full editor and disc support are included and the program is supplied with comprehensive

Price £59.00 + VAT

#### X CAL

An expert computer-aided learning package in 16K Eprom and support disc. No programming skill required to construct learning sessions as the program is screen driven. Facilities include text pages, graphics and histograms.

Price £65.00 + VAT

#### **FORTH**

FIG-FORTH in 8K Eprom together with manual.

Price £34.72 + VAT

#### LOGO-FORTH

A 16K Eprom program introducing this very powerful but extremely friendly Turtle-graphics language. Users also have full access to the FIG-FORTH support nucleus. Full documentation is included.

Price £59.00 + VAT

Retail/Mail Order/Dealer Enquiries to:-

H.C.C.S. Associates 533 Durham Road, Low Fell, Gateshead, Tyne & Wear NE9 5EY. Tel: (0632) 821924

Retail sales also at:-**H.C.C.S. Microcomputers** 122 Darwen Street, Blackburn, Lancs. Tel: (0254) 672214

ECM<sub>10</sub>



#### **GOLDEN APPLES OF THE SUN:**

The Golden Apples have been stolen and hidden in seven different locations. Can you recover them all? There's a surprise once you have. Hi-res graphics and text.

#### STOCKMARKET:

Test your skill on the stockmarket. Prices are influenced by your own actions, and Government actions — just like the real thing! See if you can make a million. Text £5.95

#### ALIEN ODDESSY:

A four-part adventure game. This tape contains the first two parts, in which you must escape from the Castle, then journey across the Great Grass Plains to the Mountains of the Moon. Hi-res graphics and text.

#### MINI-GAMES:

Four short games on tape consisting of Blackjack, Maths Test (5 levels of difficulty) Guess the Number, and Layers, a game in which you try to survive a year in the farming business. Text.

#### INTER-PLANETARY TRADER:

You are the Captain of a Starship. You have to buy a cargo, and attempt the inter-stellar jump to your destination. But beware, meteors and space pirates are out to get you. Text.

#### DRAGON TI-99/4A for SPECTRUM 48

DATABASE: (DRAGON)

A personal filing system we can modify to suit your own requirements. Please ask for quote. Approx. £15.95

SURPRISE: (DRAGON)

Regain the magic ring, but to do so you must first find the key to the Tower, avoid robbers, and more. Then bewitch the Dragon, and you're home and dry — almost. Hi-res graphics and text.

SCANNER 13: (DRAGON)

Set in the City of the future, this game combines the best elements of both arcade and adventure games. Destroy the evil Drones before they destroy you and your City. Three levels of difficulty, Hi-res graphics and text.

£8.45

BOPSWIZZLE: (DRAGON)

A splendiferous fun game! Beat the ghastly Gloops and the yucky Yerkies, amongst other nefarious nasties. Collect pearls at the same time! Low and hi-res graphics and text. £5.95

AMAZING: (DRAGON)

Series of five mazes specially for the under 5's ranging from quite simple to fairly complex. An excellent way to amuse preschool children, and they learn from it too. Hi-res graphics. £5.95

ALONE AT SEA: FOR THE TI99/4A (T1-99/4A)

Try and escape the sinking ship, but don't forget your supplies which are hidden somewhere. Text

K-64 (T1-99/4A)

A mind-bender. Cover the squares once only using the knight and its valid moves. Easy?! Full graphics. £6.50

MYSTERY MANOR: FOR THE SPECTRUM (SPECTRUM) Find the murderer before he (or she) finds you and your career as Detective Solvit! Graphics and text.

MASTER CODE: FOR THE SPECTRUM (SPECTRUM) Based on the famous game. Try your skill against the computer. You CAN beat it . . . Graphics and text. £6.50

All available immediately from Bamby Software, Leverburgh, Isle of Harris PA83 3TX. Includes our no quibble guarantee. Access orders welcome by mail or telephone: 085982 313 Dealer Enquires Welcome and 48 hour delivery

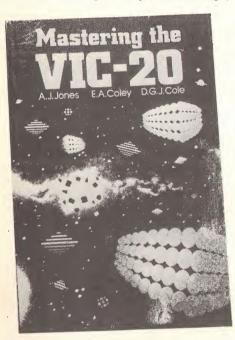
#### Each month Harry Fairhead will look at a selection of recently published books and software.

The vast array of books and software currently available presents the microcomputer user with a bewildering choice. This page is intended to help readers by presenting an informed and considered opinion about a couple of books and pieces of software each month. Because space is limited, this review page will be selective, and only books and software that seem to offer a good deal will be included. Every book reviewed on this page can be obtained through the ECM Book Service.

#### RECOMMENDED READING

Mastering the VIC-20 by A. J. Jones, E. A. Coley and D. G. J. Cole Ellis Horwood Limited, 1983.

The VIC-20 is a popular micro that has been rather neglected when it comes to books. Its users will therefore be pleased to welcome a book specifically about their machine. That this is not a book for the beginner is apparent in the first chapter, which presents a breathtakingly whirlwind tour through the topics of variables, strings, arrays, FOR loops,



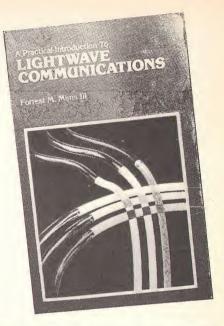
structured programming, PEEK, POKE and binary arithmetic and, finally, logical operators. The reader needs to have a good grasp of all this material before they read the chapter so little is done to explain the ideas introduced. The BASIC program contained in this chapter enables the VIC to be used as a two octave keyboard. It is therefore a particularly attractive program and one that uses the techniques discussed, although the link with the rest of the chapter is perhaps not clarified sufficiently. The second chapter tackles the problem of array storage and introduces the idea of using the cassette

buffer memory to store a byte array. In the next chapter an alternative way of acquiring space for this purpose, by lowering the top of memory, is presented along with an introduction to the 6561 video generator's control registers. Chapter Four deals with userdefined graphics and hi-res graphics and again covers a lot of ground very rapidly. The next two chapters are about peripherals - the keyboard, the cassette unit, the disk drive and IEEE-488 interface, and the printer and accessories - the games port, memory expansion port and user port. Chapter Seven is entitled "System Architecture" and presents a block diagram, a discussion of interrupts, the BASIC interpreter and the 'Kernal' machine code subroutines which can be accessed from the users own machine code programs. The final chapter is a comprehensive, and therefore necessarily compressed, introduction to machine code programming. Two appendices are devoted to programs. Appendix I presents a BASIC program for a 'Startrek-type' game and Appendix II gives two hi-res graphics routines for drawing and saving and for printing them out. The final appendix is devoted to the memory map, ASCII codes and keyword codes - all useful data.

This book has been written by professionals who are used to much larger computer systems than a humble micro. This certainly shows in their approach and style and limits the book's appeal. If you are a proficient programmer and already understand your VIC you will find a lot of useful information in this book. If you are a raw beginner then it will not help you to master the rudimentary aspects of computing.

A Practical Introduction to Lightwave Communication by Forrest M. Mims III Howard W. Sams, 1982

Fibre optics and their use in communications systems is a subject that is much talked about but, apart from very costly professional systems, very little is actually done. In part this lack of action is due to the difficulty in finding the right sort of information. Books either seem to deal with the Heath Robinson approach using garden hose pipes filled with water or plastic filaments obtained from clothes lines, or are so academic that it is difficult to find any English between the



formulae! I am happy to say that "A Practical Introduction to Lightwave Communication" falls into neither of these categories. Starting off with a little history, the book quickly moves on to consider the simple optical theory behind the use of lenses as collimators and the way that light travels in fibre light guides. The treatment is at about the right level to introduce such topics to the electronic engineer. Chapter Four outlines the problems encountered in handling fibres, cutting and joining etc. Chapter Five deals with the electronic side of the technique, that is, modulation, transmission, coding etc. The characteristics of entire systems including loss and noise analysis are investigated. Although fibre optics must be the most interesting area of lightwave communications from the point of view of computers, free space transmission is also covered and this might provide a few ideas for novel applications.



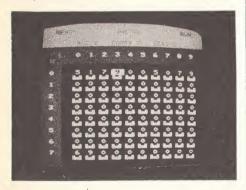
This certainly isn't a build-it-yourself book. However it does outline what you need to know to evaluate and design your own fibre optic systems. This knowledge coupled with one of the many fibre optic evaluation kits that are now on the market (see RS components for example) should produce something of practical value. There is still the need for something a little more directly aimed at the small computer user and experimenter but for anyone with a background in electronics, lightwave communication is a book that will provide much information.



#### SELECTED SOFTWARE

#### Peeko-Computer for the BBC Micro Models A and B Acornsoft

Peeko-computer is not a new idea, it first saw the light of day running on the Acorn Atom, but it is a program that deserves to be better known. It is a software simulation of a simple computer that, not surprisingly, looks very like a simplified 6502 microprocessor. It has a single accumulator, or A register, and 80 bytes of memory. The instruction set is also considerably reduced to just 10 instructions, although you can load an additional set of 10 when you are ready to try something more advanced. The standard 10 instructions include load and store, addition and conditional jump so you can write some fairly convincing short demonstration programs.



The advantage of using a simulation is that the program can be executed an instruction at a time and the contents of all the memory locations and the register are displayed at each step. Above all a simulation is as safe and friendly as BASIC and complete beginners can enter programs and make mistakes without losing control of the machine and, along with it, any hope of finding their mistake! Peeko computer is a good machine code trainer and should at least be considered by anyone about to learn or teach machine code, especially 6502 machine code.

#### Vu-Calc for the ZX Spectrum 16K or 48K Psion

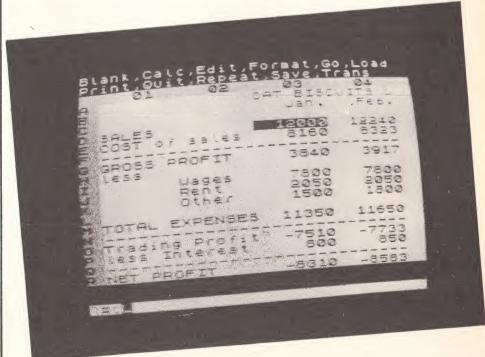
Spread sheet calculators are one of the mostsought-after programs for home computers. Essentially they allow you to handle data in rows and columns and apply mathematical formulae in an ordered way. They are therefore the tool you need for financial or simple statistical analysis. There is an initial problem to overcome with any spread sheet calculator and getting to know how to use it is difficult - especially if you are not used to handling data ina similar way by old fashioned methods. However, if you have a need for this type of analysis - either for a small business or equally for household accounts - it is well worth the effort of putting in the time needed to let your computer do the number crunching for you. It saves time later

in trying to balance the books by finding out where your mental arithmetic went wrong!

The only documentation with this program is contained on the cassette inlay which folds out to give seven pages of information. This gives the details you require but if you are already familiar with spread sheet programs in general it does not give you a feel for the software's potential. Fortunately Psion have included an example on the reverse side of the tape which you can tinker with to learn about its features. I rather wish that the example had been discussed in the program notes, perhaps even with exercises—after all many Spectrum users will never have used similar programs.

Vu-Calc is reasonably fast at applying formulae by virtue of being written almost entirely in machine code. The grid used by Vu-Calc is larger than the screen area and so the screen acts as a 'window' and you see part of the whole spread sheet at any one time. Using the cursor keys you can move your position on the screen and the window shifts, revealing different sections of the whole grid in response to the cursor's movement. It has a fairly simple menu structure and you have four options for formatting data.

Although it has been written for either a 16K or a 48K Spectrum it is easier to use with the larger RAM capacity. With 48K you have more room for formulae and this is very important if you are trying to do analysis of any complexity. There is an editing facility for altering formulae which is most useful if you want to do more than one type of analysis on the same date. This is the sort of program you need to use in order to discover its potential and you need practice with it before you can use it successfully. Personally I've got lots of jobs lined up for it that I've been laboriously doing by hand and I'm very glad to have made its acquaintance. E&-CM



#### Look what your ZX81 or Spectrum can do with a TIME CONTROLLER

#### REAL TIME CLOCK & INPUT/OUTPUT PORT

AMAZING FEATURES AT A VERY LOW COST Battery backed up Real Time Clock with month, day, date, hours, minutes and seconds. Program to control the Clock in on board PROM MEMORY — saves your computers

Only ONE LINE in your BASIC PROGRAM is needed to read or write the date and time.
Eight programmable OUTPUT channells (TTL

Eight programmable INPUT channels (TTL

PRICE AMAZING VALUE ZX81 TIME CONTROLLER only £34.50, SPECTRUM TIME CONTROLLER only £38.50. If you can buy a similar product at a lower price, we will match it.

DEALER **ENQUIRIES** WELCOME

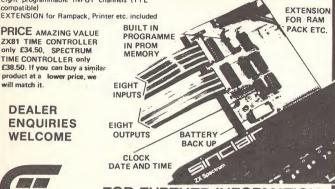


#### Glanmire Electronics

h Hill Park eld ENI IPH phone: 01-366 3245 (24 hrs)

Meenane, Watergrasshill, Čo, Cork, Ireland Telephone: 016 JJ3-21-889209 (24 hrs) Telex 75444 CTT

POSSIBLE APPLICATIONS INCLUDE: POSSIBLE APPLICATIONS INCLUDE: Home Control, Electronic Diary with Alarm, Programmable Timer, Sophisticated Burglar Alarm, Auto Stopwatch, Sound Effects, Time & Date Displays, Light Chaser, Disco Control Console, Auto Telephone Dialer, On/Off Switch Control, Temperature Control, Power Monitor ing, Automatic Testing, Robot Control, Counter, Process Control, Scientific Applications, Lab. Experiments, Time Recorder etc.



#### FOR FURTHER INFORMATION

Please send me more information on the following. Time Controller for ZX81 & Spectrum

Products for the Apple II Computer

NAME.

\* SCREEN DUMP ROM \* - copy any screen in any mode.
- compatible with MX80, FX80, RX80, CP80, GP100, GP250, etc.
- fast machine code dumps.
- screen magnification factors

x1, x2 or x4.

- plugs into page ROM socket.

£15.00 inc. VAT and p&p

DEALER ENQUIRIES WELCOME -- GENEROUS QUANTITY DISCOUNTS AVAILABLE

#### **B.B.C. ACORN COMPUTERS IN** LEICESTER

Specialists on hardware and software

\* Fully authorised ACORN-BBC Dealer \* \*\* Complete after sales service – repairs and maintenance contracts\*

ANALYSE DISC \* recover information from damaged

discs.

- copy protected discs.

- protect your own valuable software.

- full documentation giving details of disc organisation in addition to how to use ANALYSE.

£15.00 inc. VAT and p&p

Plus four utility programs including disassembler, merge and repeat programs £18.00

BBC B MICROCOMPUTERS IN STOCK

DAC Disc Drives ......£212.00 inc. VAT A to B Upgrade Kits ......£66.70 inc. VAT

Games Joysticks ......£25.00 Epson FX80 ...... £429.00 Data Cassette Recorders ...... £39.00

12" Monochrome Monitor ..... £100.00 Epson RX80 ....... £318.00 BBC Paddles ...... £14.00 Most of the best software in stock including Acornsoft, Programpower, Computer Concepts, Superior Software, Nibblesoft, Fisher-Marriott

etc. A wide selection of Books, Magazines and accessories

See a demonstration of the PLS Digitiser - £120.00 PHARMACISTS – call for a demonstration of our high-speed, comprehensive label printing system.

All our prices include VAT but please add £5.00 postage for any major item (computers, monitors, discs etc.) Please call and visit our new showrooms at:-

> D.A. COMPUTERS LTD., 104 London Road, Leicester.

(2 mins from Railway Station). Closed Mondays

Telephone: (0533) 549407

ECM10

#### ORIC SOFTWARE

Dept., ECM3, 118 Worcester Rd, Malvern, Worcs., WR14 1SS SPECIALIST SUPPLIERS OF ORIC SOFTWARE

#### SPECIAL PRICE **48K ORIC** for only £129.00

Post Free UK only

AVAILABLE NOW SOFTWARE CATALOGUE FREE WITH EVERY PURCHASE OR SEND £1.00 WHICH WILL BE DEDUCTED FROM YOUR FIRST ORDER

This is a Comprehensive catalogue of software just for the ORIC computer, with descriptions and titles for all the software have available. Some of the titles are listed here.

(Dealership enquiries welcome - apply on letterhead) ZODIAC 48K 9 95 BIORHYTHMS 48K SYNTHESIZER ARK 7.95 MULTIGAMES - 5 Games 7.95 48K 48K 9.95 ORIC BASE - Database 48K 14.95

Postage & packing 50p (107 cassettes)

Return to:- ORIC SOFTWARE, Dept. ECM3, 118 Worcester Rd, Malvern, Worcs., WR14 1SS. Tel: Malvern (06845) 62467

I have a 16K Oric.	Mr/Mrs/Miss/Ms
48K Oric.	Address
My Software interests are	
Home Business	0
Games Education	Postcode
Others (please specify)	Cheque enclosed
	Please debit my Access/Visa AMex Dclub -
	with £
•••••	No

SOFTWARE WRITERS: Lump sum or royalty payments. Send tapes & details. (Tapes not returned unless return postage is included).

#### DRAGON/ATOM/ORIC-1

ADD LOW-COST I/O POWER WITH A VIA BOARD

Drive extra I/O devices, from LEDs & switches to extra peripherals. Link 2 micros for data/program transfer, spool listings to a second micro to print/save etc. (see TEVLINK below).

HARDWARE: 6522 VIA provides 16 I/O lines + control, serial port, 2 timers. interrupt register. I/O, voltage & interrupt lines taken to 26-way IDC plug for easy connection to peripherals etc. Connectors available for Dragon and Atom. The Board may be interfaced to most other 6502/6809 micros, and may be shared between m/c's by changing the plug-in connector.

SOFTWARE: 'TEVLINK' package provides 2-machine parallel link (2 Boards needed), overall speed about 8 K DATA bytes/second with error checking. A PRINT SPOOLER is included (only 1 Board needed): connect printer port to VIA board on receiving micro and use normal LIST/PRINT etc.

Specify 25 or 27 series. Assembled Board ...... £15.00

PROFESSIONAL QUALITY DRAGON SOFTWARE:

TML-DATABASE: A flexible, general-purpose data filing and retrieval program, with an "Auto-Reminder" feature for birthdays, appointments etc, plus a powerful search facility. M/code program .....

ORIC ADVENTURE: Tevrog's Kingdom is a real-time text adventure for the 48K Oric. It features spells, clues and problems, as well as enemies and allies - can you steal King Tevrog's Talisman before he returns? Although no two games are the same, the distribution of items around the layout is logical rather than totally random, giving a game which retains its interest even after you have succeeded several times. Excellent value for money. Cassette ...... £5.75

Other software and hardware available soon \*

MAIL ORDER ONLY. SEND FOR LISTS/DETAILS A!! prices fully inclusive of VAT, p&p etc.



Tevward Microtech Ltd. (Dept. ECM), 403 Dallow Rd., Luton LU1 1 UL (Telephone: (0582) 418906

ECM<sub>10</sub>

# SPEECH RECOGNITION SYSTEMS

Mike Furminger, of Nene College, Northampton, outlines the basic principles of a micro based speech recognition unit.

The idea of talking to a computer then getting an answer in plain English has long been a popular one in science fiction. The reality of talking to a computer though is not quite as easy as having a conversation with another person. Speech Recognition is being used in modern helicopters and commercial planes, however, and enables pilots to call up desired displays on a VDU rather than looking for an instrument amongst many required by the aircraft.

#### Alternative Approaches

Computers can understand certain words when an operator has 'taught' the computer the word before or, can analyse each syllable of the sound and try to create a reasonable match to the that word against a stored library of sounds. It is possible to buy speech recognition boards which will recognise up to 100 words with 99% reliability, however these are expensive and unsuitable for home use.

To make a small home computer recognise words is a little tricky, but reasonable results can be obtained if the computer is not expected to discriminate between similar words spoken by the same person. In order to appreciate how machines can understand the spoken word it's necessary to examine the basics of human speech.

In principle spoken words are made up of a series of basic elements. There are 'Voiced' and 'Unvoiced' sounds, i.e. sound which uses the mouth to form the noise and sound which is just blown from the lungs. An example of unvoiced sound is the word 'Oh'. The voiced sounds are very complex but simply can be identified as one of three major groups i.e. fricative, sibilant and plosive sound. Fricative sound uses the tongue to make the sound as in 'fur', sibilant sound is the 's' sound and plosive sound is a sudden release of air by the mouth as in the word 'pop'. Although the above is not a complete analysis of spoken sound it is adequate for an introduction.

#### Analysis Techniques

To analyse these different sounds so that a computer can recognise different words it's necessary to use some technique which breaks down the complex wave form into a manageable spectrum. If we had a large mainframe computer to hand then we could try, for example, the linear predictive coding (LPC) technique used by the Texas company's speech chips. In principle LPC creates a series of speech frames (eg 40 per second) in which the frequency, amplitude, duration and sound type is converted to a binary code. This binary code is then saved in a relatively small memory. Recognition would occur if an incoming speech pattern matched a known one.

The techniques of LPC are beyond the scope of a small microcomputer but simpler approaches to the problem can be used. A spectrum analyser, such as used to control disco lights, would be a suitable method. The spectrum analyser breaks down a complex spoken word or musical note into its frequency elements. This is similar to the way in which a prism breaks white light into different colours but instead a sound is broken down to elements like notes on a piano keyboard.

#### Spectrum Analysers

Many designs for spectrum analysers have been published by various magazines. These are either based on a series of op-amp filters or use

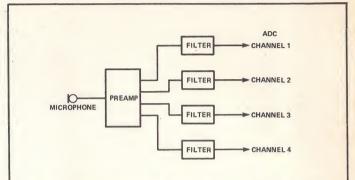


Figure 1. Block diagram of a Spectrum Analyser. After amplification, the speech signal is divided into four frequency bands.

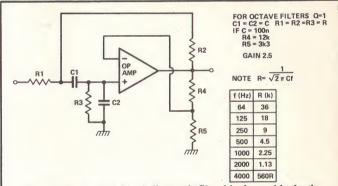


Figure 2. Each of the block diagram's filter blocks could take the form of an active filter based around an op-amp.

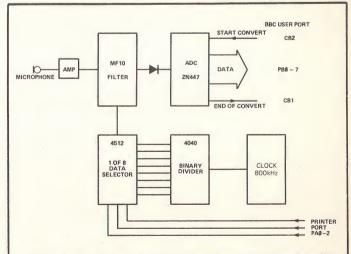
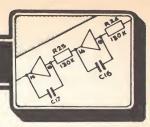


Figure 3. An alternative to an op-amp filter - this filter is built around a Switched Capacitor block.

#### **TECHNICAL FEATURE**



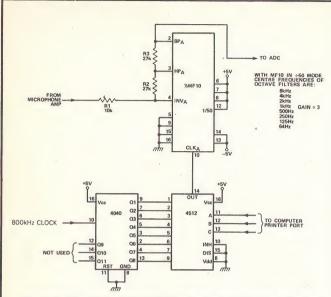


Figure 4. Circuit details of the filter section of the block diagram of Fig 3.

#### Program 1. This illustrates the way in which words can be saved as in the outline of Fig 5a.

a switched capacitor filter such as the MF10. Either approach will work well enough, so it a spectrum analyser is already to hand then this is another use for it. If you have not got a spectrum analyser then building a basic model is not too difficult. With a BBC model B computer a very simple device could be built using filters into each of the 4 ADC channels. Suitable filter frequencies are mentioned later. All other computers will require a multiplexed ADC to accept the signal data.

Another approach is to use an MF10 controlled with various clock rates to reproduce many filters in one as shown in Fig. 3.

#### Sound Experiments

The author used a PET computer fitted with an Eventide 30 1/3 octave filter spectrum analyser and consequently all examples are quoted for a PET computer, the method described though can be transferred to any other machine. The properties of speed will dictate which filters are significant.

Unvoiced sound tends to have a broad spectrum with a maximum around 500 Hz, the exact frequency depending on the physical size of the speaker. Voiced sounds can be identified by their properties, since sibilant sound is a high frequency hiss around 8 KHz, plosives are low frequency sounds around 150 Hz and fricative sound tends to be more difficult to identify but mostly its components are around 1 KHz. There is no useful information to be found below 50 KHz or above 10 KHz. If only a few channels are used then it is a good idea to keep the above points in mind.

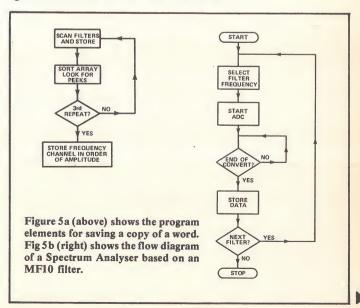
A suitable 8 channel octave set of filters would have centre frequencies at 62, 125, 250, 500, 1000, 2000, 4000 and 8000 Hz.

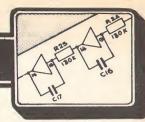
#### **Software Outlines**

The software for speech recognition on a microcomputer would first store a copy of a word, then compare any incoming word with the stored copy. The more comparisons that are required the slower will be the response.

The program elements for saving a copy of a word are shown in Fig 5a.

An example of these procedures on the PET computer are given in **program 1**, lines 330 to 570. The program fills an array with the stored data from the spectrum analyser, sorts for peaks and then sorts again into channel order with a bubble sort.





Program 2. This illustrates the way in which a computer could perform a simple 'sex test' based on the fact that males have peak vocal frequencies of less than 500 Hz while females have higher dominant frequencies.

```
100 PRINT"CHANGEMANE YOU TURNED ON THE"
110 PRINT"MUREAL TIME SPECTRUM ANALYZER⊞?"
120 GETA$:IFA$<>"Y"THEN120
125 PRINT"MCCLLECTING DATA"
   125 PRINT"MCOLLECTING DATA"
130 DIMM(30),B(30),C(30)
140 SYS4096*11
150 K=1:N4="UP":GOSUB700
166 K=2:N4="DONN":GOSUB700
170 K=3:N4="LEFT":GOSUB700
170 K=3:N4="LEFT":GOSUB700
190 PRINT"DMOTHE COMPITTE IS NOW PEADY TO PLAY"
210 FORI=1TO2000:NEXT:GOTO1100
220 POKE46080,1:REM GAIN MAX
230 A=USR(5):POKE931,255:A=USR(3):REM CLEAR
240 A=USR(7):A=USR(8)
250 A=USR(4)
       250 A=USR(4)
                                 | A=USR(4)
| POKE931,0:REM FREEZE
| PRINT"$YES?"
| A=USR(3):IF PEEK(826)<50THEN285
| FORK=110100
| A=USR(3)
| NEXT |
| PRINT"$ |
| FORE=atn2991EP2
 338 FORF=0T029STEP2
340 A(F)=PEEK(827+F)+PEEK(828+F)+PEEK(829+F)
350 NEXT
360 KK=0:REM FIND PEEKS FROM 50HZ
370 FORII=0T012
380 KK=K+1
390 IFKK>28THEN480
400 IFA(KK)>A(KK+1)THEN420
410 IFA(KK)<=A(KK+1)THEN480
420 B(II)=KK+1:C(II)=A(KK)
430 KK=KK+1
440 IFKK>28THEN480
450 IFA(KK)>EA(KK+1)THEN470
460 G0T0430
       330 FORF=0TO29STEP2
 450 IFR(KK)<=R(KK+1)THEN470
460 G0T0430
470 NEXTII
480 FORI=0T012:SW=0:REM BUBBLE SORT
490 FORJ=0T012
500 IFC(J)>=C(J+1)THEN530
510 T=C(J):C(J)=C(J+1):C(J+1)=T:SW=1
520 T=B(J):B(J)=B(J+1):B(J+1)=T
540 IFSW-J
540 IFSW=0THENI=12
540 IFSW=0THENI=12
550 NEXTI
550 IFH0(I)=B(I)THENR0=R0+1
650 IFH1(I)=B(I)THENR1=R1+1
650 IFH2(I)=B(I)THENR2=R2+1
650 NEXTI
650 NEXTI
650 IFR0-R10NDR0)=R2ANDR0>R3THENP=P+40:RETURN
650 IFR1>R0ANDR1>=R2ANDR1>=R3THENP=P+40:RETURN
650 IFR2>=R0ANDR2>=R1ANDR2>=R3THENP=P+1:RETURN
660 IFR2>=R0ANDR2>=R1ANDR3>=R2THENP=P+1:RETURN
660 G0000220
                                       6010229
                                     END
REM COLLECT FILES
                                 PENT COLLEGY FILES
OPENI, 8, 15
FL$="0:"+W$+", SEQ, READ"
OPENI3, 8, 13, FL$
FORW=0109
INPUT#3, H(W)
ONKGOSUB810, 820, 830, 840
                                     NEXTW
CLOSES
CLOSES
790 CLUSE1
300 RETURN
310 H0(W)=H(W):RETURN
320 H1(W)=H(W):RETURN
330 H2(W)=H(W):RETURN
340 H3(W)=H(W):RETURN
350 REM GAME
                                   DATA"
870 DATA"
                                   DATA"
                                     DATA"®
                                 DATA" **

DATA" 
                               DATA"
1000
1010
```

```
DATA" RECORD 100
                                                                                            SEC
    1050
   1060 DATA"
1070 DATA"
1080 DATA"
  1000 DATA"
1090 REMRITE TO SCREEN
1100 PRINT"3":PRINT
1110 FORI-1T020:READP$:PRINTP$;:NEXT
1120 RESTORE
1130 T3=VAL(MID$(P$,8,7)):IFT3(10THENTT3=100
   1140 P=33173:POKEP,42
1170 T=TI
1180 P1=P
1190 GOSUB220
  1190 GOSUB220

1200 IFPC>P1THEN1220

1210 PRINT"STOPPED":GOTO1530

1220 G=PEEK(P)

1230 IFQ=102THEN1270

1240 IFQ=97THEN1390

1250 POKEP1.32:POKEP.42

1260 GOTO1180

1270 REMCRASH

1270 REMCRASH
                  FORI=1T0100
POKEP,97
    1280
    1290
1300
1310
                POKEP,105
POKEP,95
    1320 POKEP, 98
    1330 POKEP,105
1340 POKEP,95
1350 NEXT
    1360 POKEP,42
   1360 POKEP,42
1370 POKEP,42
1370 POKEP1,32
1380 PRINT",";:PRINT"CRASHED
1390 T2=TI:TI=(T2-T)/60:TI=INT(100*T1):T1=T1/100
1490 PRINT",LAP TIME"TI"SEC
1410 IFTI(T3THENPRINT",HEW RECORD"
1420 IFTI(T3THENGOSUB1440
1430 GOTO1530
1440 REMSTORE RECORD
1450 S=1952
                                                                                                                                                                  ":GOTO1530
  1440 REMSTORE RECORD
1450 S=1952
1460 T$=STR$(T1):L=LEN(T$)
1470 FORI=1TOL
1480 Y$=MID$(T$,I,1)
1490 POKE(S*I),Y
1500 POKE(S*I),Y
1510 NEXT
1520 RETURN
                   FORW=1T01000:NEXT
    1530
    1540 GOTO1090
READY
```

It is a good idea to loop round the recording program 3 times and take the best match. This ensures any odd noises are removed, as in lines 575-630.

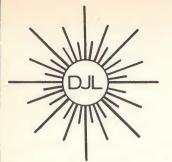
A simple 'sex test' could now be performed since the maximum energy channel would indicate the frequency which is significant to the speaker. Males have peak frequencies of less than 500 Hz, females and children have a higher dominant frequency. This is not foolproof but good fun.

Speech recognition with this system is possible if the order of channels is saved in a file. Then when an incoming word is required to be recognised the stored files are compared with the channel order of the incoming word. This can be a 50% match being OK or finding the best match. Neither system is particularly good in the simple form. The problem is that BASIC is slow and if several matches are made for one word (about 16 per second would be a good idea) then the sort and compare becomes too slow. A job for machine code!

If only simple words or noises are compared then a single sample will work well. To demonstrate this try out a musical instrument and see if different notes are recognised. A game can be written where words or music drives a car round a track, or the words are used to control a simple robot. This system only allows pre-recorded words to be compared whereas some professional systems attempt to recognise words as they are spoken. The principles of this system are simple. The challenge is for you to improve the system.

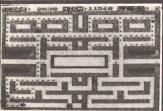
E&-CM

1020 DATA"



DEPT YC, 9 TWEED CLOSE, SWINDON, WILTS SN2 3PU Tel: (0793) 724317 Trade enquiries welcome

Export Orders: Please add £1.00 per tape airmail





#### ZUCKMAN ZX81 (16K)

- \*ALL MACHINE CODE (10K)
- \*FOUR INDEPENDENT GHOSTS
- \*HIGH-SCORE 'HALL OF FAME'
- \*AUTHENTIC ARCADE ACTION
- \*TITLE/DISPLAY MODE

ONLY £4.95 INC. p&p

#### FROGGY ZX81 (16K)

- \*MOVING CARS, LOGS, TURTLES
- \*ALLIGATORS, DIVING TURTLES
- \*FOUR 'SCREENS' OF ACTION
- \*ALL ARCADE FEATURES
- \*ENTIRELY MACHINE CODE

ONLY £4.95 INC. p&p

## X Spectrum FROGGY 16K or 48K

SPECTRUM VERSION OF ARCADE GAME WITH FULL ARCADE FEATURES:—

- \*Fabulour Hi-Res Colour Graphics \*Authentic Sound Effects + 3 Tunes \*3-D Logs, Swimming & Diving Turtles \*3 Lanes of Multi-coloured vehicles \*On-screen Score, Hi-Score, Time-bar
- \*On-screen Score, Hi-Score, Time-bar
  \*Snake, Alligators and Baby Frog
  \*Top 5' High-Score initials table
  \*Demonstration Game routine

\*Demonstration Game routine Your home-sick frog must leap across a

busy main road, then onto logs and turtles in the river to reach safety of the riverbank frog-homes.

THIS MACHINE-CODE GAME MUST BE SEEN TO BE BELEIVED!!

ONLY £5.95 INC. P&P

FCM10



#### YOUR QUICK-LEARN WAY TO PROGRAMMING OR ENGINEERING

IN YOUR OWN HOME, IN YOUR OWN TIME, AT YOUR OWN PACE.

Learn computer programming quickly and easily through the renowned ICS "Open College" system, taking the course at your own pace and in your own time.

Use the famous ICS study texts, backed up by your own expert tutor, and learn computer programming, the proven way, with

ICS home study.

Introduction to Computer Programming

Programming in BASIC Programming in COBOL

The ICS School of Electronics offers home study courses in:

Basic Electronic Engineering

Computer Engineering



Approved by CACC Member of ABCC

#### ALL DETAILS FREE—SIMPLY RETURN THE COUPON BELOW

PLEASE SEND ME YOUR PROSPECTUS ON

COMPUTER PROGRAMMING ELECTRONICS – PLEASE TICK



Name \_\_\_ Address\_

Div. National Education Corporation

Post to: Dept M348

ICS School of Computer Programming 160 Stewarts Road, London SW8 4UJ ECM10



#### A+G COMPUTERWARE

#### PRINTER SPECIALS THE NEW FX100 EPSON PRINTERS & CALL

Epson FX80 £370 New RX80/FT £309
Star DP510 £269 Star DP515 £369
Shinwa CP80 £269 Microline 80 £213
Microline 82A £297 Seikosha GP100 for VIC20 £177
Seikosha GP100A(P) £189 Seikosha GP250X £231
SEIKOSHA GP700A COLOUR PRINTER £390!!
STROBE GRAPHICS 100 PLOTTER £365
SMITH CORONA TP1 DAISY WHEEL £350

JUKI 6100 DAISY WHEEL .....£390

LOTS MORE ON OUR LIST

#### MONITORS

 Phoenix 12" Green Hi-Res
 £99
 Phoenix 12" Amber Hi-Res
 £109

 Kaga Colour 380 Dot
 £218
 Kaga Colour 510 Dot
 £258

 KAGA COLOUR 630 DOT
 £356
 RGB CARD & CABLE, APPLE
 £79

 RGB CABLE FOR BBC
 £7
 £7

#### **APPLE SOFTWARE**

SEND FOR MARCO LIST — LOTS OF NEW GAMES ADDED BARGAINS FOR EVERYONE — JUST PHONE!!

#### **BBC PLOT/STROBE**

Complete package ready to run on BBC. Includes Strobe Graphics, 100 Plotter. Pack of 10's plus Paper — BBC Software (disc or cassette) Interface Cable complete with Demonstration Program. Special Introductory Price £370

EDUCATIONAL and GOVERNMENT ORDERS WELCOME
FAST DELIVERY BY INTERLINK

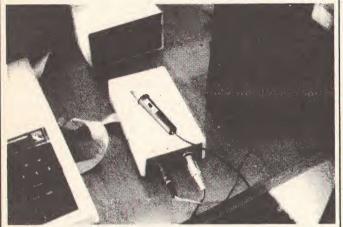
CARRIAGE £8 — PLEASE ADD VAT TO ALL TOTALS

Tel: 061-428 2014 PO BOX 34 CHEADLE CHESHIRE SK8 4PT



#### Give your BBC Micro a **REAL** voice.

With the Voxbox voice digitiser.



Normal human voice can now be stored on disc and accessed from your own programs. Store words or phrases in English or any other language. The Voxbox comes complete with a speaker, microphone and full operating software to enable you to build your own voice files. Just plug into the User Port.

> It speaks for itself. Price all inc. £89.00

**Multiplex Computer Services** 

250, Eastern Road, Brighton BN2 5TA.

Tel: (0273) 606860

ECM10

310 STREATHAM HIGH ROAD, LONDON SW16 6HG Tel: 01-769 2887

Open Tues.-Sat. 10.30 am to 5.30 pm (Closed Mondays)

SOFTWARE FROM ALL THE BEST SUPPLIERS - OVER THE COUNTER -PLUS GROWING RANGE OF PERIPHERALS. SEE IT BEFORE YOU BUY IT.

SAE appreciated for catalogue — but please specify for which computer.

DRAGON ZX SPECTRUM 7X81

#### BEEB BOUTIQUE

NEW BBC & DRAGON SOFTWARE DEPARTMENT DAILY DEMONSTRATIONS

KEYBOARDS BBC-ACORN ADD-ONS CASSETTES

NEW! - BUFFER CLUB for regular customers. Special Offers - Lectures - Foreign Trips -Software Promotions. Ask for details of membership on your next visit.

MEMBER OF THE COMPUTER TRADE ASSOCIATION — YOUR FAIR DEAL GUARANTEE

VISA - ACCESS - AMERICAN EXPRESS - DINERS CLUB ALL CARDS WELCOME

# London 29,30 September

Inside: Informa

The wonderful world of the PCW Show opens up again on 29th and 30th September and 1st and 2nd October.

And, like every previous Show, it's the one and only place for the newest, biggest, smallest, costliest, cheapest, finest, micro hardware, software, bolt-ons and books.

Where the big news breaks first. At the Personal Computer World Show

you'll see the launch of some astonishing new kit, fascinating

TICKETS!

software and vital peripherals.

Know the world of personal computers.

Just about every micro manufacturer, software vendor, and goodie supplier will be at the PCW Show.

There'll be special deals on offer, too, as well as the chance to enter the Computer Scrabble R competition, and watch the 4th European Computer Chess championship.

Plus the MicroComputing Centre, Computer Town, Computer Clubs, and more.

The time and place for everything. Make sure you visit the PCW Show. It's on from Thursday September 29th until Sunday October 2nd, at the

Barbican Exhibition Centre in London. It'll be fully signposted, and is easy to reach by tube, bus or car.

The PCW Show: £3.00-but to you £2.50.

Clip and keep this voucher to save 50p when you buy a PCW Show ticket on the day.

#### PCW SHOW 50p DISCOUNT VOUCHER

This youcher entitles the bearer to 50p (fifty pence) discount on the full £3.00 entrance fee to the Personal Computer World Show.

The organisers reserve the right to admission. Only one voucher per person/entrance. ECM10

# 

4



Inside...
Two special offers...
Six new software titles...
Nicrodrive!

# Something for everyone, from Sinclair!

Welcome to another Sinclair Special. Even if you're not yet a Sinclair owner; I believe you'll find something of interest in this latest issue.

For instance, if you're looking for the best way to begin computing, turn to our back page. You'll see that leading Sinclair retailers are now offering the popular ZX81, complete with a 16K RAM Pack and a free software cassette, all for £45. That means savings of at least £29 on one of the world's all-time best-selling computers.

Those same retailers are also offering the ZX Printer at its regular price of £39.95, but accompanied by a free 5-roll Paper Pack, worth

If you want to add even more speed and versatility to your ZX Spectrum system, you'll be pleased to hear that the new ZX Microdrive has now been officially announced.

Microdrives are being released on an order of priority basis.

Spectrum owners who purchased direct from us will be sent order forms, in a series of mailings that begin with the earliest names on our list of Spectrum owners. If you didn't buy direct from us by mail order, send us your name and address (use the coupon in this Sinclair Special). We'll add your name to the list, and send you a colour brochure and details on how to order.

Finally, if you're looking for more ways to use your ZX system, take a look at the software opposite. There are programs for programmers, a space-chase and car race for arcade-game players, a brand new logic game for those who've exhausted 'the cube.'

The Cattell IQ Test is based on the definitive professional psychologists' test – and forms an accurate but easy way of measuring your own IQ. All the new programs are available direct from us, through the order form in this issue.

You'll see what I mean about Sinclair having something for everyone. And we'll have even more to show you at two forthcoming exhibitions: the PCW Show at the Barbican Centre, from September 28th to October 2nd, and the Great Home Entertainment Spectacular at Olympia, from September 17th to 25th

tigel Semle

Nigel Searle, Managing Director Sinclair Research Ltd.

## ZX Microdrive System preview!



#### **ZX MICRODRIVE**

At least 85K bytes storage, loads a typical 48K program in as little as 9 seconds: £49.95.



#### **ZX MICRODRIVE CARTRIDGE**

Compact, erasable, revolutionary. Complete with its own storage sleeve. Contains up to 50 files, with a typical access time of 3.5 seconds: £4.95.



#### **ZX INTERFACE 1**

Necessary for sending and receiving information from ZX Microdrive. Includes RS232 interface and local area network facility for 2 to 64 Spectrums. Attaches to the underside of your Spectrum. Purchased with ZX Microdrive, just £29.95. As separate item, £49.95.

#### PSYCHOLOGY, GRAND PRIX RACING, BRAIN TEASING, PROGRAMMING, SPACE-BLASTING!

Sinclair have it all taped with six brand-new programs for ZX Computers!



**Chequered Flag** For 48K RAM Spectrum. £6.95

Have you ever wanted to drive a Formula One car flat-out round a Grand Prix circuit? With Chequered Flag you'll need one eye on the road and one eye on the instruments, as you steer and brake to avoid hazards, and work through the gears in search of the lap or race record. This outstanding new program puts you in the driver's seat with stunning realism, and gives you a choice of three cars and ten different circuits. Don't crash!



Mothership For ZX81 with 16K RAM. £4.95

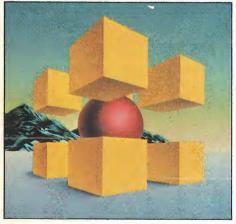
Scream down the claustrophobic confines of the Zarway. Engage suicidal drone fighters in deadly laser combat. Dodge, duck and dive in a high-speed 3-D race to attack the evil Mothership before she claims your home planet. Mothership is a truly tough challenge, and fast, furious fun!



**Cattell IQ Test** For 48K RAM Spectrum. £12.95

Although there are a number of socalled self-administered IQ tests on the market, the only reliable way of finding your IQ has-until now-been to visit a qualified psychologist and take a battery of tests - for a fee. Now Victor Serebriakoff, International President of Mensa, has produced Professor Cattell's test in a form which enables you to use your ZX Spectrum to test your IQ.

The Cattell Scale IIIA test is timed by the computer, marked immediately. and the marks standardised against your age. This is the first time that an accredited, standardised test has been available to the general public.



Zeus Assembler For 48K RAM Spectrum. £12.95

A powerful and easy-to-use programming aid, designed to simplify the entire process of producing machine code programs, enabling you to write in assembly language instructions. Comes complete with comprehensive range of support facilities.



**Monitor and Disassembler** For 16K & 48K RAM Spectrums. £12.95

This powerful Disassembler translates machine code into comprehensible assembly language instructions, allowing you to examine the BASIC ROM, to investigate the workings of the Spectrum or to analyse your own machine code routines.

With the highly versatile Monitor, you get an extensive set of facilities to aid the entry, inspection, modification and debugging of your own machine

code programs.



**Flippit** For 16K or 48K RAM Spectrums. £9.95

Like those cube games, Flippit looks simple. But its fiendish ingenuity results in the ultimate game of logic and patience. Twist, turn and swap the nine Flippit pieces in search of the elusive magic square. But be warned, those pieces can be arranged in millions of combinations...

#### TWO SPECIAL OFFERS FROM SINCLAIR

# **STARTER**

Powerful passport to home computing - now at the lowest price ever!

#### **ZX81**

Sinclair ZX81-900,000 sold so far. Touch-sensitive keyboard...black and white graphics...just plugs into most TV sets. With 212-page BASIC manual - step-by-step guide to the world of personal computing. Normal price £39.95.

#### ZX 16K RAM PACK

Gives the ZX81 more power-the power to run sophisticated software like Flight Simulation and Chess. Normal price £29.95.

#### CASSETTE

Worth £4.95 or more. In every starter pack, there's a top-flight 16K cassette-like Chess or Fantasy Games or one of the valuable education series. Actual title varies with availability. And once you own your starter pack, there are 37 other Sinclair cassettes available (plus dozens from other manufacturers).

Look for the special packs at WH Smith, Boots, John Menzies, Currys and other leading Sinclair stockists. Not available by mail

Offers subject to availability while stocks last.

Section A: hardware purchase



#### **ZX PRINTER AND** FREE 5-ROLL **PAPER PACK:** £39.95



Section B: software purchase

#### ZX PRINTER

Designed exclusively for use with the Sinclair ZX81 and ZX Spectrum personal computers. Printing speed: 50 characters per second. 32 characters per line, 9 lines per vertical inch. Plus graphics direct from screen. Now with a free pack of 5 rolls of special paper (normal price £11.95).

Sinclair Research Ltd, Stanhope Road, Camberley, Surrey, GU15 3PS. Telephone: (0276) 685311.

#### How to order

Simply fill in the relevant section(s) on the order-form below. Note that there is no postage or packing payable on Section B. Please allow 28 days for delivery. Orders may be sent FREEPOST (no stamp required). Credit-card holders may order by phone, calling 01-200 0200, 24 hours a day. 14-day money-back option. ZX81 Starter Pack and Printer and Paper offers are not available by mail order.

To: Sinclair Research Ltd. FREEPOST, Camberley, Surrey, GU15 3BR.

	-			
Qty	Item	Code	Item Price	Tot £
	ZX Spectrum – 48K	3000	129.95	
	ZX Spectrum – 16K	3002	99.95	
	Postage and packing:	0029	4.95	

3 JATOT

ZX81 Starter Pack and Printer and Paper offers are not available by mail order.

Item Price Total Code Qty Cassette FOR SPECTRUM 4403 12.95 L4/S Monitor & Disassembler 12 95 4402 L3/S Zeus Assembler G26/S Flippit 4025 9 95 P1/S Cattell IQ Test 4500 12.95 G31/S Chequered Flag 4030 6.95 FOR ZX81 2125 4.95 G26 Mothership

Signature

\*Delete/complete as applicable.

\*I enclose a cheque/postal order made payable to Sinclair Research Ltd for £

\*Please charge to my Access/Barclaycard/Trustcard account no:

Address

ECM 910

3 LATOT

**ORDER FORM** 

**ZX Microdrive information request** 

Please add my name to the Microdrive Mailing List, and send me a colour brochure with full specifications of ZX Microdrive/Interface 1 [ ] (tick here). You can use the above form to send us your name and address.

#### The Data Store

6 CHATTERTON ROAD **BROMLEY** KENT

for the BBC MICRO

#### OFFICIAL ACORN DEALERS

WIDE SELECTION OF SOFTWARE AND PERIPHERAL EQUIPMENT INCLUDING

EPSON, NEC, SEIKOSHA PRINTERS

> ZENITH. CABEL **MONITORS**

> > CUMANA **DISC-DRIVES**

BOOKS AND CABLES AVAILABLE plus our personal advice service

MACHINES DELIVERED & SET UP IN YOUR HOME

PHONE 01 460 8991 (9.30 - 5.30) ORPINGTON 26698 (Evenings) (CLOSED WEDNESDAY)

#### ECTRON

#### LIMITED STOCKS

Brand new havard H452, power supply and Nickel charger, output 13 volts at 0.7A (max 1 amp) 7" x 3" x 31/2" appx. Fully cased and boxed only £4.95 p&p £1.70.

SPECIAL OFFERS WHILE STOCKS LAST

Mullard 2" Red LED's 06p, 7805 38p, 7805KC 5 Volt 1.5A **75p**, 78H05 5V3 AMP £3.50, 5K¾" multiturn trim pots 14 for £2.50.

DISC DRIVE BONANZA PERTEC FD650 DSDD 8"..... Bargain of the year: TEAC (FD 55F) ½ height DSDD, 40 or 80 track selectable 96TPi. Brand new, fantastic reduction £199 +VAT.

FRUSTRATED Export Order. Bargain of the year. Epson FX80 Printers. Brand new and boxed. Limited stocks. £350 + VAT (Carriage £12 TNT).

MONITORS - Brand new. Fully cased. Green phosphor.

STD Video Input 9" 18MHz bandwidth ..... £80 + VAT 12" 22MHz bandwidth .... £88.70 + VAT (carr. £8 TNT)
DISC DRIVE CONNECTORS

34 way IDC ..... .....£3.25 (p&p 30p) 51/4 DC Power Plug ...... £1 (p&p 30p) 8" DC Power Plug ...... £1.35 (p&p 30p) 8" AC Power Plug ..... .. £1.35 (p&p 30p)

DISC DRIVE CABINETS complete with power supply. Will take 1 full height drive, 2 by ½ height drive or 1 by ½ height drive £30 + VAT OR £40 + VAT if purchased without a drive from us. (p&p £3).

KEEP YOUR EQUIPMENT COOL. Brand new 3" box fan 220 volts AC, 50Hz. 1uF capacitor required .... £7.95 (p&p £1)



11 HERCIES ROAD, HILLINGDON, MIDDLESEX UB10 9LS, ENGLAND **TEL: UXBRIDGE 55399** 



#### CASSETTE DUPLICATION SERVICE

No order too large or too small. Fast efficient service using only the latest studio equipment

need cassette copies in a hurry? We can provide a super-fast service at a slight extra cost try us! We aim to please.

Delivery at cost Blank C12 Cassette Tapes 34p plus VAT, also Cassette Labels at £2.75 + VAT per 100.

JIC 49 Castle St., Barnsley, South Yorkshire, S70 1NT Phone: 0226 87707

As we try to maintain a fast service we cannot accommodate visitors and telephone enquiries preferred after 6pm.

## COMPLITER 22

Make It Feel Wanted Get It A Friend From

Let your ZX computer answer back with....

Allow it to form any words using simple commands, full step by step instructions are included ...

Only £32.00 (+£1.00 for demo cassette)

Or why not allow your ZX computer to play you MUSIC/GUNSHOTS/LASER ZAPS/ETC/ETC....

MULTI SOUND GENERATOR is what its name implies. Many sounds are possible — all from easy to use commands as explained in the instructions. Only £24.50 (+£1.00 for demo cassette) BOTH THE ABOVE UNITS ARE CASED. Got a VIC-20? Fancy learning morse code? Cassette Only £4.95

For further details phone 0942-893573. Cheques/postal orders to: ADD-ON-ITS 34 Withington Dr, Astley, Manchester M29 7NW Please   Add 50p P&P.	
□ Spectrum NAME	
□ ZX81 ADDRESS	
□ ORAT	
□ M.S.G.	
□ VIC/Code	

# COMPUTER-THE ANALOGUE

Paul Izod and Alan Stirling describe the means by which the E&CM computer can gain access to the world of measurement and control.

# FEATURES

- ★ Choice of inexpensive 8 bit or high performance 12 bit A-D convertor
  - 8 analogue input channels, either single ended or differential.
    - \* Provision for sample and hold amplifier.
- A-D conversion time of less than 35us per channel (12 bit)
  - ★ Conversion may be triggered externally.
     ★ Minimal S/W overhead once the board is set up.
- ★ Up to 8 boards per system for 64 channels.
  ★ 2 low cost 12 bit D-A convertors.
  - \* 8 digital O/P lines.
- \* 8 digital I/P lines with external clock/enable.
- ★ All I/O connections may be from PCB connector block on front of the board.

The analogue board has been designed with a wide range of users and applications in mind, and for this reason may appear somewhat complex. If all the facilities aren't required then the component count may be substantially reduced.

The digital I/O and analogue output stages are very straightforward, but an overview of the analogue input circuitry may be useful.

digital conversion started. After the signal is internally or externally triggered. The board When the trigger arrives, the S & H holds the input signal, the trigger is synchronised with digitised it is stored in the internal RAM, and the next channel is selected (well - almost; a A configuration register is used to specify single or repetitive scan and whether will then select the first channel and keep the the processor clock and the analogue to This continues until every specified channel has been digitised. The board will then either wait for the next trigger or proceed immediately to the first channel again, according to the configuration register. the channel number or scan range, select Sample and Hold (S & H) in sample mode. pipe-line is used to speed up the process)

Access to the internal RAM is interleaved between the board and the processor using the E clock. The processor may therefore read the RAM at any time.

# **Bus Interface**

D1 and D2 decode address bits A17 down to establishing the board at F2XX within a separate the block of RAM addresses from address map is arranged to accommodate up to 8 of these boards, such that the RAM 64K boundary. Address bit A7 is used to addresses appear continuous, to facilitate rapid reading of the analogue input channels. A6, A5 and A4 are decoded by D3 in conjunction with a 1 out of 8 switch. The switch position determines the board number and hence address within the system. See decode signal. This enables the data bus buffer and is used in the remaining decoding the block of configuration, DAC output Fable 1. The switch common is the board registers and byte I/O addresses.

D20 is completely enabled only when the board is addressed on a write cycle. The

reason the CLK (via D9) appears in the been enable logic of D20 both indirectly via D3 chan and D15, and directly from D9, is to decode On A7 low and ensure that D20 is deselected exterapidly at the end of a processor cycle, before transithe data on the bus becomes invalid. This is conwhy ALS parts are specified for D9 and the D20. It is necessary to latch data on a write high cycle at the tail end of the cycle because the circ on board RAM is updated whilst CLK a frof (processor E clock) is low.

D28 decodes the Read signals for Input byte and the high and lower order bytes of RAM.

# **DAC** Output Registers

D52 and D53 supply the least and most significant bytes respectively for DAC0; similarly D55 and D56 drive DAC1. It should be noted that the DAC80 requires inverted input data, and as all registers on the data bus are cleared on reset, the outputs of DAC0 and DAC1 will rise to their most positive value.

# Configuration Register and Timing Circuitry

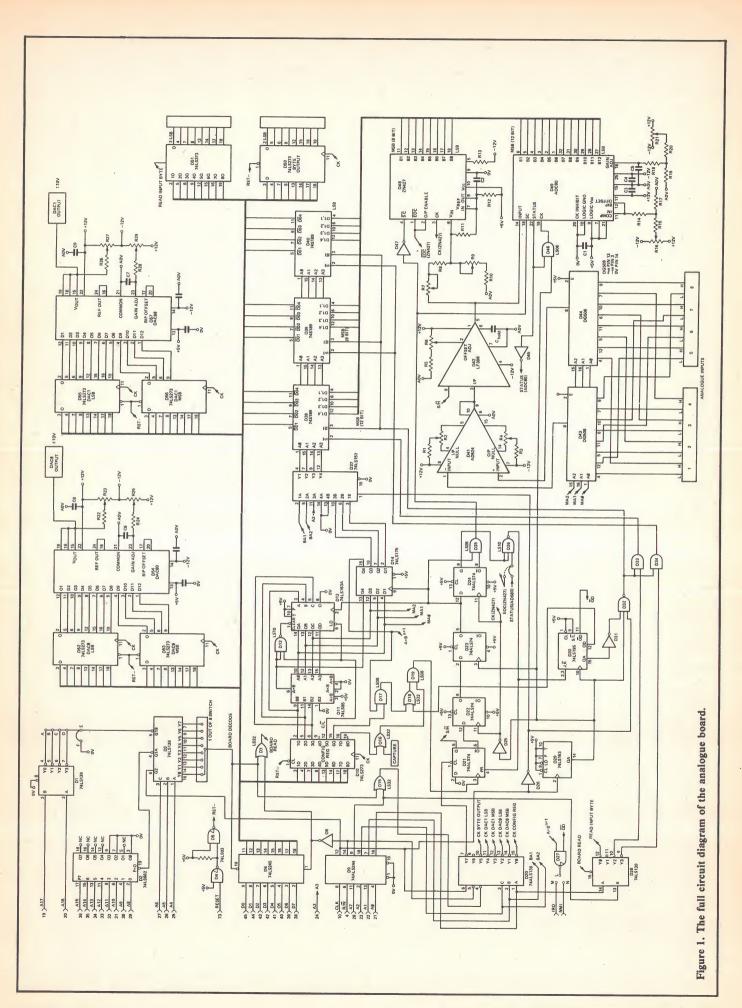
Bits D0, D1 and D2 of D10 set the channel number or scan range. If bit D4 is set, then as counter D13 is incremented such that its output equals scan range, as determined by comparator D11, the counter will be synchronously cleared next cycle. If bit D4 is cleared though, the channel number in the configuration register will always be loaded into the counter. Bit 5 is used to enable or inhibit the retriggering of the timing generator internally, via D17. Bit 6 determines whether the trigger will be internal or external. When Bit 6 is high D19 will always be enabled, regardless of the external Capture signal.

Assume that the configuration register has

controls the Sample and Hold, so this freezes the input signla. The D input of D22 is now high. This and the remainder of the timing circuit are clocked by the E clock ÷ 2, to give and then D23 will therefore change in state according to E, thereby synchronising the external trigger to the clock. Two stages are wasn't met and its output entered an unstable been set up for repeated acquisition of On the rising edge of Capture (supplied ransferring 0 to Q and 1 to Q. The Q output necessary in case the set-up time of D22 state. This would very likely have ended before its output was transferred to D23 on he next edge of clock. Both edges of clock a frequency of 500kHz. The output of D22 channel 1, to be initiated by external trigger. externally) flip-flop D21 will be clocked, are used to expedite this process.

The Q output of D23 clocks both the address counter D13 and the address latch, D14. This enables the latch to hold the address of the signal in the S& H, whilst the address counter is incremented. By selecting the next channel now, the maximum settling time is given to the instrumentation amplifier, before its output is sampled by the S& H.

D24 and D35 produce the Start Conversion signal for the A-D convertor. It is important that this signal is synchronised to the convertor clock. The system now waits for the End of Conversion signal. When this occurs the output of D36 goes low, presetting D31, priming the trigger circuit and switching the S& H back into sample mode. The low from D36 is clocked through D30 which, via D31-D34, generates the RAM enable and write pulses (whilst E is low). The data is now secure in the memory. As the circuit was configured for repetitive conversion, when QD of D30 goes low, it will clock D21 (via D18 & D19) and the whole process will be repeated.



#### The Data RAMs

D3 is a 2:1 line multiplexer controlled by the processor E clock. When E is low and the board controls the internal data bus, the RAM address is derived from the address latch D14, and all 3 RAMS are updated together at the end of a conversion. When E is high the RAM address is from address bits A3, A2 and A1. A0 is used to select the upper or lower byte.

Note that the 74S189/74LS189 memories shown invert the data and are therefore suitable for use with the ADL80 (which has complemented outputs). If the ZN427 is used, the non-inverting 74LS219A may be more appropriate.

#### Power Supplies

The performance of this analogue board depends to a significant extent on the voltage, stability and noise of the power supplies. Although switch mode power supplies are suitable for the +5 V, it is unlikely that they would be satisfactory for the analogue circuits, especially if 12 bit performance is required.

Best overall performance will be with ±15V supplies, and this will allow the full range of multiply-sourced devices to be used. However if it is preferred to standardise on ±12V, to maintain compatability with RS232 ports etc., this is possible – provided that the following points are observed:

- (a) Maximum analogue input voltage ±9.5 V (limited by S & H).
- (b) DAC should be either National Semiconductors DAC1280A or equivalent.
- (c) ADC either ZN427 or ADC80Z-12, ADC80AGZ-12 or equivalent.

#### **Appendix**

#### Sampling Dynamic Signals

It was briefly mentioned earlier that a Sample and Hold amplifier was necessary when digitising signals whose rate of change of voltage was fast compared to the speed of the convertor.

To illustrate this point, consider a sine wave of amplitude  $\pm 10$ V peak. The maximum rate of change of voltage will be at the zero crossing point. To introduce an error in the conversion of just ½ LSB (least significant bit), the input voltage must change by less than that voltage (½ LSB) during the conversion.

For a convertor of range ±10V and 12 bits of resolution, the voltage presented by ½ LSB is:

$$\frac{1}{2} \times \frac{20 \text{V}}{2^{12}} = \frac{10}{4096} \text{ V} = 2.44 \text{mV}$$

The instantaneous voltage of the sine input, at time t, is  $V = Vpk \sin 2\pi ft$ . This may be rearranged to find the highest input signal frequency for an error of ½ LSB (2.44mV) during conversion.

$$v = Vpk \sin 2\pi ft$$

$$\therefore \arcsin \left(\frac{v}{Vpk}\right) = 2\pi ft$$

where v = 2.44 mV, Vpk = 10 V and t = conversion time

As 
$$\frac{v}{Vpk}$$
 «1, and the sine of a very small

number tends to the number itself.

(Remember? 
$$\sin x = x - \frac{x^3}{3!} + \frac{x^5}{5!}$$

....., so as  $x \to o$  the powers of x virtually disappear).

So we are left with

$$\frac{v}{Vpk} = 2\pi ft = 0.244 \times 10^{-3}.$$

Let 
$$t = 30us$$

$$\therefore f = \frac{0.244 \times 10^{-3}}{2\pi \times 30 \times 10^{-6}} = 1.3 \text{ Hz!}$$

A surprisingly low figure, perhaps. By placing a Sample and Hold before the A-D converter, the time t is reduced considerably. Suppose that a S & H samples a signal for long enough to 'acquire' it.  $\approx 10$ us for our circuit, and is then switched to Hold, prior to conversion. Just as the device is switched, there is a small window or aperture during which the signal is captured. It is this aperture time which replaces t in the above expressions.

Substituting a typical value of  $t = 100 \,\text{ns}$ :

$$f = \frac{0.244 \times 10^{-3}}{2\pi \times 100 \times 10^{-9}} = 388 \text{Hz}$$

This is only food for thought however, because in using Sample and Hold circuits there are many other sources of potential error, especially when a LSB is a small number of mV. These include charge offset, feedthrough, gain accuracy and droop rate. There may also be offset voltages, but these can generally be nulled.

#### About the analogue components

**DG508** – This is a single ended 8 channel analogue multiplexer, which selects one input from eight, according to the 3 address

bits. The device exhibits a break-before-make switching action so that 2 inputs cannot be shorted together. It will easily accommodate signal voltages of ±10V with ±12V power supplies. Channel to channel switching time is in the order of 1ys; ON resistance is typically <400R. The DG508 is sourced by several manufacturers.

AD524 – Precision instrumentation amplifier with pin programmable gains of 1, 10, 100 and 1000. This amplifier is included not primarily for its gain but to provide differential inputs. The input and output offset voltages are very small, so that for many applications offset null circuits will not be required. The output of the AD524 will typically settle to 0.01% of a 10V input step in 15 ys. The AD524 is made by Analog Devices.

LF398 – Sample and Hold amplifier, although used as a Track and Hold on this board. This is used to capture the input signal when its rate of change is fast compared to the analogue to digital conversion time.

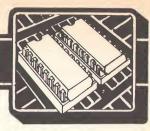
When switched from Hold to Sample, the LF398 should acquire a new signal to within 0.01% in <10ys (with a Hold capacitor of 1,000pf).

LF398 is the National Semiconductors part number. Compatible devices are made by several other manufacturers.

ADC80 – This is a well established, multisourced 12 bit successive approximation A-D converter. It requires very few extra components for basic operation, and without adjustment should be accurate to better than ±0.2% of Full Scale Range (FSR). In this circuit the ADC80 is clocked externally, in synchronism with the CPU clock, and conversion time is 26ys. By changing some links, the ADC80 can be made to perform either 10 or 8 bit conversions in less time.

Note that the converter outputs are inverted. For bipolar operation these are Complementary Offset Binary and for unipolar operation, Complimentary Straight Binary. The analogue input signal range may be selected to be  $\pm 2.5 \text{V}$ ,  $\pm 5 \text{V}$ ,  $\pm 10 \text{V}$ , 0 to 5 V or 0-10 V.

The ADC80 should soon be available in a lower cost plastic package.



ZN427 – This 8 bit A-D converter is made by Ferranti and is widely available. It must be clocked externally and requires both gain and offset adjustment. Ratiometric operation is possible with this device.

Conversion time is typically 10ys, but as the processor clock (divided by 2) is used, it will be 18ys in this circuit. Both unipolar and bipolar analogue input ranges are catered for by external resistors.

The outputs of the ZN427 are non-inverting.

DAC80 – An industry standard counterpart to the ADC80, sourced by several manufacturers and already available in a plastic package (low cost), the DAC800P-CBI-V. It is a 12 bit D-A converter with output voltage ranges of ±2.5V, ±5V, ±10V, 0 to 5V and 0-10V. This voltage output can source or sink at least 5mA and will settle to 0.01% of FSR within 5ys for a 20V output swing. (For this performance ±15V power supplies may be necessary).

Next Month - Constructional Details.

Board position 1	F280 Channel 1 M.S. Byte (Read)
F200 Configuration Register (Write) F201 DAC0 M.S. Byte (Write) F202 DAC0 L.S. Byte (Write) F203 DAC1 M.S. Byte (Write) F204 DAC1 L.S. Byte (Write) F205 Byte Output (Write) F206 Spare (Write)	F281 Channel 1 L.S. Byte (Read) F282 Channel 2 M.S. Byte (Read) F283 Channel 2 L.S. Byte (Read) F284 Channel 3 M.S. Byte (Read) F285 Channel 3 L.S. Byte (Read) F286 Channel 4 M.S. Byte (Read) F287 Channel 4 L.S. Byte (Read) F288 Channel 5 M.S. Byte (Read)
ZF207 Internal Trigger (Write) F208-F20F Repeat of above (Write) Byte input may be read at every even	F289 Channel 5 L.S. Byte (Read) F28A Channel 6 M.S. Byte (Read) F28B Channel 6 L.S. Byte (Read) F28C Channel 7 M.S. Byte (Read) F28D Channel 7 L.S. Byte (Read) F28E Channel 8 M.S. Byte (Read)
address from F200 to F20E.	F28F Channel 8 L.S. Byte (Read)

Board position 2	F210-F21F and F290-F29F
Board position 3	F220-F22F and F2A0-F2AF
Board position 4	F230-F23F and F280-F2BF
Board position 5	F240-F24F and F2C0-F2CF
Board position 6	F250-F25F and F2D0-F2DF
Board position 7	F260-F26F and F2E0-F2EF
Board position 8	F270-F27F and F2F0-F2FF

Table 1. The analogue board's 1 of 8 switch determines the board number according to the table.

#### **BBC OWNERS**

Why not consider the HOBBIT FLOPPY TAPE SYSTEM for your computer?

The HOBBIT gives you all the facilities you would expect from a floppy disc at a fraction of the price.

BRIEF SPECIFICATIONS: Read/Write speed of 7500 BAUD per second • Capacity: 101K BYTES per CASSETTE • Average access time 22 seconds • Up to 120 FILES per CASSETTE

Completely automatic — no buttons to press
 Fully built, boxed and tested. Just plug in and go
 System can support TWO DRIVES
 Connects to user port
 Works on all operating systems

No disc interface

Available from stock PRICE £135.00 plus VAT

Manual only £1.50

Postage £3.00

**★ NOW AVAILABLE ★** 

ZERO MEMORY OPTION
Enables the Hobbit to operate without using any of the Beeb's memory
Price £25.77 + VAT

For more details contact:

KON

**COMPUTER PRODUCTS** 

KILN LAKE LAUGHARNE CARMARTHEN DYFED SA33 4QE Tel: (099 421) 515

Or available from most good Computer shops

ECM10

Also available for NASCOM computers PRICE £120.00 plus VAT

Access and Barclaycard accepted

# OPTIMAL CODING

James Dick examines various data compressing techniques and examines their application in a variety of systems. We make no apologies for the 'in-depth' treatment of this important subject area.

Communication is one of mankind's most necessary skills and today communication can mean talking to another person or to a machine. The sole aim of communication is to transfer information from source to destination. The language involved may be made up from a descriptive (English) or prescriptive (eg Spanish) dictionary composed of character strings (words) which are, in turn, synthesised from a palette of characters (A...Z). The palette is normally representative of the range of available sounds preduceable by the transmitter (speaker) and decipherable by the receiver (listener).

All communications contain a certain amount of redundancy, for example, English, most of the definite and indefinite articles may be omitted without losing meaning. Physiologists imply that most people can still perceive speech when 70% is missing or otherwise corrupted. This is why redundancy is important—in a noisy environment enough of the message is detected to make sense. The Hamming code and other error-correcting codes are examples of controlled redundancy being added to the basic message to improve readability.

#### **Information Theory**

Information theory is the name given to describe the results of studying the general communication problem. One section is referred to as source coding, the principle is to use the minimum of characters to convey a message—in a phrase 'optimal coding'. The importance of optimal coding has increased as the electromagnetic spectrum becomes more crowded. As reducing the number of characters in a message increases the capacity of a given channel to transmit data.

#### Entropy

Entropy is loosely defined as a measure of randomness. The more random a given system is, the higher the system's entropy and this concept may be used to define the efficiency of any system used for optimal coding.

If a given system is expected to transmit K messages where each message is unique and if each of the K messages has a probability of being sent P(i) where i=1...k then if all the messages have equal probability the binary word length is equal to

If the probabilities are not equal, the entropy, in bits, is given by

$$E = -\sum_{i=1}^{k} P(i) \log_2 (P(i))$$

In information theory, the entropy is a measure of the information content associated withy a set of messages and gives a lower limit on the number of characters (bits) required to encode the messages. The Average Word Length (AWL) for a set of messages is

#### NON-UNIQUE CODE

M<sub>1</sub> = 00 M<sub>2</sub> = 01 M<sub>3</sub> = 1 M<sub>4</sub> = 000 Mes...iges 1 to 4 with associated codewords

Wordstring 0001 may be decoded as M<sub>1</sub> M<sub>2</sub> or as M<sub>4</sub> M<sub>3</sub> and hence is not uniquely decodable

Figure 1. Any coding system must provide 'uniquely decodable' code. This system fails to do this.

#### SHIFT (ORDER 2) CODE

Message	Message probability	S <sub>2</sub> code	Natural binary	
M <sub>1</sub>	0.35	0.0	000	
M <sub>2</sub>	0.25	0 1	0 0 1	
M <sub>3</sub>	0.15	10	010	-Note: The "11" that represents the
M <sub>4</sub>	0.12	{11300	011	binary for the 4th message is used
M <sub>5</sub>	0.08	1101	100	as a "label" to indicate a new series of three has started
M <sub>6</sub>	0.03	1110	101	or three has started
M <sub>7</sub>	0.02	111100	110	
	$\Sigma$ = 1.00	AWL - 2.54	AWL = 3.00	

Figure 2. A shift code in which the last unused basic word is used to indicate an extension.

#### CONTINUATION BIT CODE (ORDER 2)

Message	Message probability	CB <sub>2</sub> code	Inserted continuation bit: may be zero
M <sub>1</sub>	0.35	X00	or one depending on value used by last
M <sub>2</sub>	0.25	X 0 1	code word sequence
M <sub>3</sub>	0.15	X 1 0	
M <sub>4</sub>	0.12	X 1 1	
M <sub>5</sub>	0.09	X00X00	
M <sub>6</sub>	0.04	X 0 0 X 0 1	
	$\Sigma = 1.00$	AWL = 3.39	

Figure 3. Continuation bit codes are similar to shift codes but are not instantaneous.

#### TOGGLING OF CONTINUATION BIT

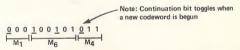


Figure 4. The value of the continuation bit is usually toggled for each word.

#### FANO CODE

Message	Message probability				Code
M <sub>1</sub>	0.35		1		11
M <sub>2</sub>	0.25	1	0		10
M <sub>3</sub>	0.15		1	1	011
M <sub>4</sub>	0.12		l ' l	0	010
M <sub>5</sub>	0.09	0	0	1	001
M <sub>6</sub>	0.04		١	0	000
	$\Sigma$ = 1.00				AWL = 2.40

Figure 5. Using the Fano code, messages are arranged by probability.

#### HUFFMAN CODING: PROBABILITY ASSIGNMENT TABLE

	Message				
Message	probability	Α	В	С	D
M <sub>1</sub>	0.35	0.35	0.35	▶0.40	▶0.60
M <sub>2</sub>	0.25	0.25	0.25	0.35 7	0.40
M <sub>3</sub>	0.15	0.15	▶0.25 7	0.25	
M <sub>4</sub>	0.12 T	▶0.13 7	0.15		
M <sub>5</sub>	0.09	0.12			
M <sub>6</sub>	0.04				
	$\Sigma = 1.00$				

Figure 6. Illustrating the rather complex technique of the Huffman code.

$$AWL = \sum_{i=1}^{k} WL(i)P(i)$$

where WL(i) is the word length in characters for the i-th message. Optimal coding attempts to get AWL close to E. The efficiency of a coding technique is often given as

$$Efficiency = 100 \times \frac{E}{AWL} \%$$

#### Codes

The previous sections have shown that a transfer of information involves the transmission of messages each with a certain probability of being used and each with a certain number of characters. It is intuitively obvious that high probability messages should be assigned a smaller number of characters than low probability messages. Adopting this technique produces 'unequal length' code.

Any coding system must provide 'uniquely decodable' code. This means that any series of words may only be decodable in one way. Fig 1 shows a code which fails to do this.

#### Shift Codes

Define a shift code of order n to use words n bits in length as the basic high probability word-length. The choice of n will depend on the number of messages with a high probability. The basic word allows  $2^n$  code words. The first  $(2^n-1)$  messages are given codes, usually in natural binary sequence. The last and unused basic word is used to indicate an extension. Fig 2 shows an example.

#### Continuation Bit Codes

These are particularly suitable where message probability obeys a power law, e.g.

$$P(m_i) = i^{-c}$$

where

P(m<sub>i</sub>) is the probability of the ith message and c is a positive constant

Each message is given a (n+1) length code where n is the order of the continuation bit code used. The extra bit, usually inserted at the most significant end of the code word, indicates whether or not the next word is an extension. Fig 3 shows a B2 code; the similarity with the shift system is very evident. The shift codes are instantaneous while the continuation bit codes are not: the next bit has to be examined to determine whether the end of a particular word has been reached. The value of the continuation bit is normally toggled for each word. See Fig 4.

This type of code is easily implemented in hardware.

#### Fano And Huffman Codes

The Fano code, and the Huffman system described below, are two nearly-optimal codes with efficiencies commonly greater than 75%. At first sight they appear very similar but subtleties in the latter give it greater efficiency.

For the Fano code, the messages are arranged by probability as shown in **Fig 5.** The groupings in (0, 1) pairs gradually build up the code words.

The Huffman code is similarly constructed. A table of messages and their probabilities is made. To proceed from left to right, the two smallest probabilities are combined and re-entered in the next column until there are only two probabilities left. The code words associated with each message are then generated by traversing the table in the retrograde direction assigning a bit value of 0 to the probability which was the result of an addition in the next (ie leftmost) columnm. Fig. 6 illustrates this rather complex coding technique.

Next month we look at some practical applications of the ideas expressed here including a look at Image Storing using such techniques as Run Length Coding and Differential Pulse Code Modulation.

### EASIBINDERS

Quick, neat and easy!

#### It's A Bind . . .

If your issues of **E&CM** are piled in an untidy heap in the corner of your attic. Thumbing through back issues for that little bit of software you **know** we've published or for that interface that you meant to build last year but never got around to it.

We've now got an answer to the problem with our **NEW**...

#### **Electronics And Computing Binders**

Each binder is designed to hold 12 issues and features the **E&CM** logo.

only £4.85 Fully Inclusive (overseas orders add 35p per binder)

Payment by Access/Visa, National Giro (A/c No. 5157552) or Cheque/PO

Please allow 28 days delivery.

London, N1 6NS

#### **Order Form**

Please supply	Electronics And
Computing Monthly Binders	

Address ....

2.....

Send Orders to:
EASIBIND, 42 Hoxton Square,
London, N1 6NS

Registration No 735718





#### OCTOBER CHOICE

others.

Simple Interfacing Projects ...... £7.95
by Owen Bishop

This book contains a variety of interfacing projects, ranging from the relatively simple which a beginner can easily build to those requiring more experience of construction. They include a voice-operated controller, a sound processor, a music generator, a digitiser pad, and

#### **NEWNES BEGINNER'S GUIDES**

A popular series of handy information-packed volumes, intended for the comparative newcomer.

	Bishop Beginner's Guide to Electronics	£4.95
	☐ Fry Beginner's Guide to Computers	£4.95
	☐ Parr Beginner's Guide to Microprocessors	£4.95
	☐ Sinclair Beginner's Guide to Digital Electronics	£4.95
	☐ Sinclair Beginner's Guide to Integrated Circuits	£4.95
[	Stephenson Beginner's Guide to Basic Programming	£4.95

#### **TEXAS "UNDERSTANDING" BOOKS**

A series of informative books designed for "anyone who wants to learn easily and quickly more about today's electronic technology and personal computing".

Understanding Computer Science	£4.95
Understanding Communications Systems	£4.95
Understanding Digital Electronics	£4.95
Understanding Microprocessors	£4.95
Understanding Solid-State Electronics	£4.95

☐ Barden Z80 Microcomputer Design Projects ........... £13.95 ☐ Barden Z80 Microcomputer Handbook .......................... £12.85

#### **Z80 BOOKS**

Clarcia Build Your Own 280 Computer - Design
Guidelines and Application Notes £16.25
Coffron Z80 Applications £12.25
Khambata Introduction to the Z80 Microcomputer £11.95
Leventhal Z80 Assembly Language Programming £14.25
Leventhal Z80 Assembly Language Subroutines £14.25
Nichols Z80 Microprocessor Programming and
Interfacing Book I £11.95
Nichols Z80 Microprocessor Programming and
Interfacing Book 2 £15.40
Nichols Z80 Microprocessor Advanced
Programming and Interfacing £17.95
 m 1 m 1 11 moo

□ Zaks Programming the Z80 ......£11.25

#### **6502 BOOKS**

	Leventhal 6502 Assembly Language Programming	£14.25
	Leventhal 6502 Assembly Language Subroutines	£13.25
	Scanlon 6502 Software Design	£12.50
	Stephenson 6502 Machine Code for Beginners	£6.50
	Zaks Advanced 6502 Programming	£11.25
	Zaks Programming the 6502	£13.25
1000		

#### LIGHTWAVE COMMUNICATIONS

Boyd Fiber Optics: Communications,
Experiments and Projects £14.55
Mims Practical Introduction to Lightwave Communication £10.95

#### **SPECTRUM**

□ Dickens Spectrum Hardware Manual	£6.50
☐ Hampshire Spectrum Graphics	£7.95
☐ Hewson 40 Best Machine Code Routines for the	
ZX Spectrum	£6.50
☐ Logan The Complete Spectrum ROM Disassembly	£10.95
☐ Logan Understanding Your Spectrum	£8.95
☐ Simpson ZX Spectrum User's Handbook	£7.95
☐ Sinclair Introducing Spectrum Machine Code	£8.95
☐ Tang Spectrum Machine Code for the Absolute Beginner	£7.95
☐ Valentine Spectrum Spectacular - 50 Programs	£5.95
□ Williams Over the Spectrum	£7.95

#### **BBC MICRO**

☐ Atherton Structured Programming with BBC Basic	£7.50
☐ Birnbaum Assembly Language Programming for the	е
BBC Micro	£9.95
☐ Cryer Basic Programming on the BBC Micro	
☐ James The BBC Micro – An Expert Guide	
☐ James 21 Games for the BBC Micro	
□ Williams Programming the BBC Micro	£7.50

#### DRAGON

Carter Enter the Dragon£6.	95
James The Dragon 32 Book of Games£6.	
Lawrence The Working Dragon 32£6.	95
Sharp The Power of the Dragon£6.	.95
Stewart Easy Programming on the Dragon £6.	95
Stewart Further Programming on the Dragon £6.	95

#### **SINCLAIR ZX81**

Baker Mastering Machine Code on your ZX81	£8.50
Costello Advanced Programming for the 16K ZX81	£6.95
Logan Understanding your ZX81 ROM	£9.95
Logan Complete Timex TS1000/ZX81 ROM Disassembly	£10.95

#### **COMMODORE PET/VIC/64**

Jones Mastering the Vic-20	£6.95
Commodore 64 Programmer's Reference Guide	£16.50
Commodore Vic-20 Programmer's Reference Guide	£10.95
Osborne The Pet Personal Computer Guide	£13.25
Osborne The CBM Professional Computer Guide	£13.25
Compute! Magazine Compute!'s First Book of Pet/CBM	£12.95
Compute! Magazine Compute!'s First Book of Vic	£12.95

#### ATARI .

Compute! Magazine is a leading U.S. magazine for 6502-based micros. These five books are by regular Compute! contributors.

□ Compute!'s First Book of Atari	£12.95
☐ Compute!'s Second Book of Atari	£12.95
☐ Compute!'s First Book of Atari Graphics	£12.95
☐ Compute!'s Mapping the Atari	£14.50
☐ Compute!'s Inside Atari DOS	£17.95

#### LANGUAGES

☐ Alcock Illustrating Basic	£4.50
☐ Brodie Starting Forth	£15.95
☐ Christensen Beginning Comal	£7.90
☐ Ennals Beginning Micro-Prolog	£7.50
☐ Finkel Data File Programming in Basic	£10.75
☐ Hogan Discover Forth	£12.95
☐ Ledgard Elementary Basic	£5.95
□ Ledgard Elementary Pascal	£5.95
☐ Winston Lisp	£10.25

#### **HOW TO ORDER**

All prices include post and packing. Just tick the boxes beside the titles you want, fill in the coupon, and send this page to ECM Bookshop. (Or photocopy the page or write out the details). Please note that prices are subject to change without notice.

#### To ECM Bookshop, 155 Farringdon Road, London, EC1R 3AD.

Please send me the titles ticked.
I enclose cheque/P.O. payable to ECM Bookshop for £.....

Please charge my Access/Visa account no.

Please charge my Access/Visa account no.												
Signed							. D	ate		 	 	 
Name (please print)												
Addres	s									 	 	 

#### TASWORD TWO THE WORD PROCESSOR

64 CHARACTERS PER LINE ON THE SCREEN AND TO PRINTERS!

#### **TASWORD TWO The Word Processor**

Your Spectrum becomes a **professional** word processor with TASWORD TWO. TASWORD TWO gives you an amazing **64 characters per line** on your screen. This is ideal for standard A4 paper and TASWORD TWO prints your text just as it appears on your screen.

Tasword Two drives the following interfaces:

Cobra RS232 I/O Port Euroelectronics Interface Hilderbay Interface Kempston Interface Morex Interface Tasman Interface

The same program drives these interfaces. A short easy to follow set of instructions takes you through setting up your Tasword Two to drive the interface you have or choose to buy. Tasword Two also drives the ZX printer.

£13.90 fully inclusive mail order price.

#### **TASWORD TWO TUTOR**

TASWORD TWO comes complete with a manual and a cassette. The cassette contains your TASWORD TWO and TASWORD TWO TUTOR. This teaches you word processing using TASWORD TWO. Whether you have serious applications or simply want to learn about word processing, TASWORD TWO and TASWORD TWO TUTOR make it easy and enjoyable.

#### **TASWORD TWO £2 Demonstration Cassette**

See for yourself the powerful features of TASWORD TWO. Send just £2 for the Tasword Two demonstration cassette. A voucher is included which gives you £1 off the price of TASWORD TWO.

#### TASWIDE - 64 characters per line!

A machine code utility program, TASWIDE doubles the information that your own programs can display. Make a simple change to your print statements and your output appears on the screen at 64 characters per line instead of the normal 32. Both print sizes can be mixed on the screen. 16K and 48K versions supplied on the same cassette.

£5.50 fully inclusive mail order price

#### TASMAN PRINTER INTERFACE

Plug into your Spectrum and drive any printer fitted with the Centronics standard parallel interface. Supplied complete with ribbon cable, connectors, and driving software.

£45 fully inclusive mail order price

All prices include VAT and post and packaging.

#### **TASMAN SOFTWARE**

ECM10

17 HARTLEY CRESCENT LEEDS LS6 2LL

#### ARCADE ACTION - ORIC-1 - ADVENTURES

#### **DINKY KONG\***

For 48K £6.95 inc.
SUPER M/C ARCADE
GAME

 9 Skill Levels, Full Colour, Platforms, Ladders, Fire-balls, Rolling Barrels, Umbrellas, Hearts, Hall of Fame, Sound Effects.

You wont see a better game for the Oric.

\*Author - Adrian Sheppard.

#### **JOGGER**

For 48K £6.95 inc.

#### **REAL M/C ARCADE ACTION**

 4 Screens, Skill Levels, Full Colour, Road, Cars, Lorries, River, Crocs, Logs, Hall of Fame, Sound Effects.

Perspire your way up the screen.



\*Author — Adrian Sheppard.

All Programs available at Lasky's

#### ORICADE

For 48K £8.50 inc.

- Assembler/ Disassembler/ Editor
- Handles full 6502 mnemonics.
   Features Save & Reload M/C
   Assembles & Disassembles at any address

You can't program seriously without Oricade.

\*Author - Adrian Sheppard.

#### GRAIL

For 48K £6.95 inc.

SEVERN SOFTWARE
\*Dinky Kong available at certain branches of W. H. Smith

#### **Exciting Graphic Adventure**

Where in the Castle Perilous is the Holy Grail? Gather armour and weapons to fight monsters. Sell treasure to a trader in exchange for strength potions and wound ointment. Where will the warp take you to? This is a test of skill, luck, logic & intelligence.

#### MORIA

For 48K £6.95 inc

A challenging adventure set in the mines of Moria.

- Can you survive encounters with the monsters of Middle-Earth? Will the wizard help you? Are you fated to dies beside the sealed doors? Or have you the power to open them? Unless you find Durins Ring you will never leave the mines alive!
- \*We guarantee to replace any tape sold by us that fails to load on receipt.
- \*Dealers enquiries welcome excellent trade terms.
- \*Ask for Severn Software at your local computer store.

Please send me yourprogram. For my Oric-1
I enclose cheque/ P.O. for £
NAME
ADDRESS
Post Code

SEVERN SOFTWARE
5, School Crescent, Lydney, Glos. GL15 5TA.



## offers the most specific of the Specific of th

"Prestel and the Prestel symbol are trademarks of British Telecommunications.

\*Subscribers are responsible for quarterly Micronet 800 and Prestel subscription charges.

M icronet 800. The spectacular service that gives micro-users access to a huge database of information, hundreds of software programs, and communication with other users.

Sinclair ZX Spectrum. The home computer that's out-shone all its rivals.

Bring the two together and it's a combination that opens up a breathtaking new world of microcomputing possibilities.

Suitable for either the 16K or 48K versions, the Prism VTX 5000 modem was designed specifically for the Spectrum and fits neatly under the micro.

Plug the other end into the outside world via your telephone and your system will give you more than you ever dreamed

To other

Spectrum

users

Spectrum

VTX 5000

possible.

Micronet 800 is fun, friendly and inexpensive to run. Choose from hundreds of free games, download and use them on your Spectrum whenever you like, play onscreen games (as easy—and inexpensive—as a local phone call), and compete in Big Prize

games and quizzes. There's also a range of downloadable games you can buy for less

than over-the-counter prices.

Learn through up-to-date education packages, and help run the household with simple business packages.

And if you need fast facts about the world of computers, Micronet 800 provides constantly up-dated product comparisons, reviews, prices, dealership and 'best-buy' information – 24-hours a day, 7-days a week.

You can access the whole range of Prestel<sup>™</sup> information covering news, travel, holidays and entertainment, together with an electronic booking service.

Keep in touch – you can send electronic mail to any other Micronet 800 or

Prestel user.

Micronet 800

The VTX 5000 provides a full Prestel screen with graphics, and an off-line message composition facility for speedy transmission when you go on-line.

You can use the Sinclair printer to print

frames and messages, or save them on tape for future use.

All this—and even more as the service grows—would normally retail at the low price of £99.95 inc VAT.

But if you join Micronet 800 before September 30, we will make you a very special offer.

Micronet 800 will provide the VTX 5000 inclusive of VAT,

post & packing and (if you need it) a free jack plug installation for the incredibly low price of £74.95 – a saving of £25 on the normal retail price.\*

So don't delay – send the coupon today.

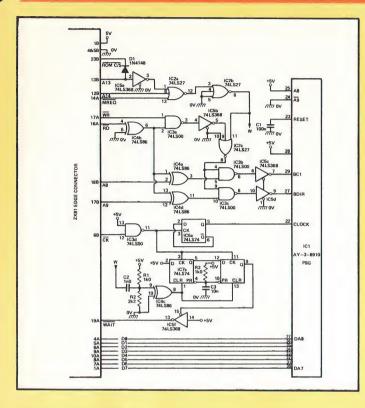
## Micronet 800 ectacular add-on

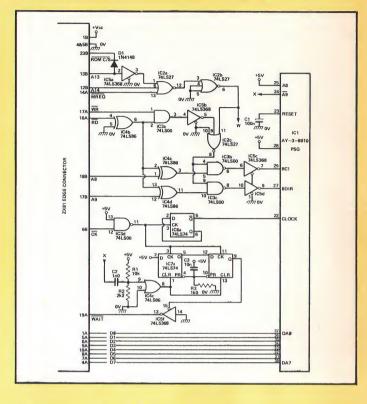
1.45.27					
1/4, 1					
		1 1			
	100		*	X	4
0	a of all		ÇÓ		

	☐ Please send me a complete Micronet 800 in		of Micronet 800 and		
	the VTX 5000, and including a Micronet sub		(Please allow		
	☐ Please send me (No.) VTX 5000 mode	em(s) at £74.95 each inc. VAT:	28 days for		
1	☐ I enclose a cheque made payable to Telem	ap Ltd. for £	delivery.)		
1	☐ I wish to pay by credit card: Visa, Access, Diners Club, American Express.  (Delete as applicable) Amount £				
i	My credit card No. is	Signed			
ı	Name A	Address			
ı		Tel:	ECM 10		

10

## WIN A TRIP TO THE 1984 LAS VEGAS CONSUMER ELECTRONICS SHOW PLUS £100 SPENDING MONEY





#### THE SHOW

At the start of every year the town of Las Vegas plays host to one of America's largest consumer electronics shows.

Vast areas of exhibition hall provide manufacturers with the opportunity to display their latest products for the Audio, Video and, more importantly for *E&CM* readers, the Home Computer Market.

In addition to the attractions of the CES, the lucky winner will also have the opportunity to sample the delights of the nightlife of the gambling capital of the world.

#### THE COMPETITION

To enter, look at the two circuit diagrams shown. On the left is the control electronics of the ZX81 Sound Board as published in our August Issue. On the right is another version of the circuit, this time with a number of subtle differences. In fact there are at least ten changes to the original diagram.

Your task is to ring all the areas in which the circuit on the right differs from that on the left and when you've found all the changes to send this page, making sure you have filled out the coupon, to the address shown below.

CES Competition
Electronics & Computing Monthly
155 Farringdon Road, London EC1 R 3AD.

#### \* PRESENTED IN CONJUCTION WITH MAGNET WORLD TRAVEL

NAME
ADDRESS
I agree to abide by the rules of the competition as shown.
Signature

#### THE RULES

Closing date for the competition is October 31 st, and the first correct entry drawn after this date will win the free trip to CES.

We are having to restrict entries to UK readers and the prize will consist of travel to the CES from London, accommodation during the show plus any admission charges to CES, and the return journey to London. The winner will receive £100 in spending money.

The winner will be responsible for obtaining a valid passport and visa as well as any additional documentation that may be required for travel to America.

No EMAP employee or their Agents or any members of their families may enter.

The Judges decision is final and no correspondence with respect to this competition will be entered into.

**CLOSING DATE — OCTOBER 31 st** 

#### ENTERPRISE TECHNOLOGY LTD.

**ENTERPRINT 1200** NEW

NEED AN RS232 PRINTER FOR £25.00



#### LOOK NO FURTHER

At last you can use the **LOWEST COST PRINTER AVAILABLE\*** PLUS the "ENTERPRINT 1200" adaptor;

this unique combination gives you:

- ★ Full Upper/Lower Case ASCII Characters
- **★ PRESTEL/TELETEXT Graphics**
- ★ 32 Characters per line, with Line Buffer
- \* RS232 Busy Signal
- \* RS232 1200 Baud Serial Input; Crystal Controlled
- ★ Z80 Micro Processor, with self test on power up ★ Character Sets in EPROM
- ★ 9V DC Operation

#### FOR ONLY £25.00 + VAT Inc. p&p

Also available: Full Spec. EPROM Programmer ZP4000 at £40.00 + VAT. Inc. p&p Special Offer

And coming shortly: The ENTREEE 488 (IEEE 488 Interface for the Spectrum).

ENTREEE 488 at £95.00 + VAT Inc. p&p

Send SAE and specify which product for details from:

#### ENTERPRISE TECHNOLOGY LTD.

(Dept. EC), PO Box 140, Wigan WN3 6LF England

°ZX Printer from Sinclair Research:- Free Roll of Paper with first 25 orders

#### **FOX ELECTRONICS**

Presents

**SPECTRUM UPGRADES** (Issue 2 Only)

16K TO 48K ONLY £21

- Simple Insertion
- No Soldering Required
- Full Step by Step Instructions supplied SEND NOW TO

#### FOX ELECTRONICS

141 ABBEY ROAD **CALLERS WELCOME** BASINGSTOKE, HANTS. TEL: 0256 20671

EAST ANGLIA'S LEADING SUPPLIER OF MICROCOMPUTERS

AND COMPON	IENTS TO EDU	CATION	AL ESTA	BLISHME	NTS.
BBC Microcompu Model B Model B + Disc Int NB Credit cards are not ac BBC Micro Econet Full range of products avai service available BBC Compatible I Cased drives, finished to ri supplied complete with complete wi	ters 346.95 431.95 ccepted in payment for diable. Installation Disc Drives match the BBC Micro are	Interface 6402 75107 75110 75150 75154 75160 75161 75162 75172 75173 75174 75175 75182		Regulators 78L05 78L12 78L15 7805 7812 7815 7905 7912 7915 LM309K LM317K LM323K LM328K	0 30 0 30 0 30 0 40 0 40 0 45 0 45 0 45 1 20 2 40 4 50 6 25
and utilities disc. All single cased drives ma configuration by the additi uncased mechanism. Disc capacity 150,000,000,000,000,000,000,000,000,000,	ry be expanded to dual on of the appropriate  Pual Uncased 335 00 142 00 449 00 216 00 545 00 260 00 are available  de Kits	75183 75188 75189 75451 75452 75453 75454 75468 75491 75492 A Y31015 A Y31270 A Y38910	0.50 0.37 0.37 0.22 0.22 0.22 0.22 0.88 0.31 0.42 D2 3.00 6.47 D6 4.40	Data Convet	01 4.26 01 3.45 01 3.00 01 5.99 01 4.75 01 2.10 01 13.00 01 2.55
BBC A2B Complete A TO BBC 3 Disc Interface Fitting service available.	84.95	AY53600 DP8304 MC1488 MC1489 NC3242A	D6 4.40 D2 6.70 D1 2.50 D1 0.37 D1 0.37 6.30	IMHz I 8432 MHz 4MHz 8MHz	2 75 1 92 0 64 0 86
BBC Micro Connet BBC21 Printer Cable BBC22 User Port Connecte & Cable BBC23 Cassette Lead BBC24 7 Pin Din Plug BBC25 6 Pin Din Plug BBC265 Pin Din Plug	7 50 2 45 3 50 0 60 0 60	MC3446 MC3448A MC3480 MC3487 MC14411 MC14412 RO32513L RO32513U	D1 2.50 D1 3.75 D5 7.30 D1 2.00 D1 7.65 9.45 D1 6.50 D1 6.50	Pins Tin Gold 8 7 16 16 10 26 16 10 29 18 13 33 20 15 37 22 17 38 24 21 46 28 24 55 40 30 76	1 W/W 25 35 40 50 60 65 70 80
BBC Micro Access BBC45 Joysticks  BBC Micro Softwa View Wordprocessor 1.2 MOS	11.30	UHF Mod UM1111 6MHz UM1233 8MHz	DI 2.60 DI 3.90	ZIF Sockets	99
BBC Micro Softwar Full range available. Plear position.  Memories 2114L-200NS DI 0.80 2708 450NS DI 2.95 2716 450NS DI 455 2716 350NS DI 495 2716 37 Rail DI 7.25 2532 450NS DI 3.85	8080 Family 8085A D4 3.50 8212 1.10 8216 1.00 8224 2.10 8228 3.27 8251A D5 2.50	Linears L203 LF398N LM301AN LM301AN LM311P LM319N LM324N LM324N NE555P NE556CP TL010 TL061	0.65 4.75 0.24 0.48 0.50 1.99 0.30 0.60 0.16 0.45 0.39 0.29	Data sheets are available on ite marked D. Prices are as fo D1 0.75 D2 1.00 D6 D3 1.25 D7 D4 2.00 D8	llows 5 2.00 6 3.00 7 4.00 8 5.00
2732 450NS D1 3.45 2732 350NS D1 5.45 2764 300NS D1 7.95 4116 150NS D1 0.85 4116 200NS D2 0.80 4118 150NS D1 3.25	8253 4.00 8255A D5 2.25 6500 Family 6502 D3 3.25 6502A D3 5.00	TL062 T1064 TL066 TL071 TL072 TL074 TL081	0.49 0.98 0.29 0.29 0.47 1.00 0.26 0.46 1.58	following production our FREI catalogue	ts is and is
6116 Low Power 150NS D2 4.95 4164 200NS TI D3 3.95	6520 D1 2.50 6520 D1 3.16 6522 D5 3.00 6522A D5 5.50 6532 D2 5.50	TL082 TL084 TL091 TL092 TL094 TL487	0.40 0.58 1.34 0.62	* 4000 Series Cl * TI Bipolar Me * 9900 Series M * Crystals * IDC, Card Ed D-Type Conne	MOS mones icros
NEC D3 3.95 4516/4816 100NS D2 2.25 4532 200NS D2 2.95 <b>6800 Family</b> 6800 D7 2.25 6802 D5 2.50 6809 D6 6.30	Floppy Disc Controllers 8271 48.00 FD1771 D5 15.00 FD1791 D6 22.00 FD1795 D6 28.00 FD1797 D6 28.90	TL489 TL494 TL496 TL507 725 741 747 748	0 62 1 63 0 60 1 33 1 60 0 14 0 48 0 27	★ Dip Jumpers     ★ Monochrome     Colour Monito     (NEC & KAG)     ★ Eprom Progra     & Erasers     ★ Custom Cable     Assemblies	& ors A) mmers
6810 D1 1.15 6821 D3 1.00 6840 D4 3.75 6845 D5 650 6850 D2 1.10 68488 D2 7.30 68500 D7 5.25 68800 D6 12.00 68810 D1 2.26 68811 D1 2.26 68811 D3 2.20	WD1691 D2 12.00 WD2143-01 D2 6.99 <b>Buffers</b> 8IL595 0.80 8IL596 0.80 8IA597 0.80 8IL598 0.80	Carriage ( post and £20 0-£1000 50 £ Prices quot of VAT and c	ed (+ camage are subject to e discounts are	199 are sent by 1st of cor 5 £200+5 00 by Sec e charges) are excluctange without not a graph of the charge of the control of t	ce
68B40 D4 6.00 68B50 D2 2.20 <b>Z80 Family</b> <b>Z80 ACPU</b> D2 2.99	8T28A 0.90 8T95 0.90 8T97A 0.90 8T98 0.90	Establishme Companies	nts, Governm	letails ome from Education ent Bodies and Pub uilable to others sub	olic



#### Companies. Credit Accounts are available to others subject to status Payment is due strictly nett by the 15th of

280 Family
280 ACPU D2 2.99
280 BCPU D2 9.00
280 ACTC D1 2.60
280 BCTC D1 2.60
280 BCTC D1 5.60
280 ADART D1 5.60
280 ADARD D2 6.95
280 ADIO D1 9.00
280 ASIO D4 9.00

Suffolk

FOR FAST, IMMEDIATE SERVICE YOU CAN TEL. YOUR ORDER TO:

DISS (0379) 898751 Midwich Computer Company Limited, Rickinghall House, Hinderclay Rd, Rickinghall,

IP221HH

is made.

Out of stock items will follow automatically, at our
discretion, or a refund will be given if requested.

For more information about the hardware and software acualable send for our FREE CATALOGUE'
Post to Midwich Computer Company Limited, Rickunghall
House, Hinderclay Road, Rickunghall, Suffolk IP22 1HH

Address Postal Code

ECM10 Telephone

When the now almost forgotten ZX80 first appreared one of its least pleasing features was its very limited integer-only BASIC that barely provided enough computing power to do anything useful, no matter what the manual might say. I think that this poor start for what has now become a powerful and very logical dialect of BASIC is responsible for the lack of attention, and indeed even derision, that ZX BASIC has received. There is perhaps a natural tendency to ignore the features of a programming language when it is available on only one or two very similar machines. In this sense comment and discussion of ZX BASIC are usually confused with a wider debate about the merits and demerits of the ZX81 or the Spectrum, Now while it isn't possible to ignore completely the hardware that a language runs on, it is possible to identify areas where the language helps or hinders the easy use of the machine.

#### A Little History

Before going on to explain the features of ZX BASIC that make it such a good incarnation of the language it is necessary to explain a little of the effect that the major dialect of BASIC - Microsoft BASIC - has had. In the

made some significant changes, in particular to the way that strings and string arrays are handled, without also providing the equivalent Microsoft commands. In my opinion the way that ZX BASIC handles strings is one of its best features and its method should become the standard. Although it is ZX BASICs string handling methods that are of most interest to users of other dialects of BASIC, the first topic to consider is the central principle behind any BASIC - expression evaluation.

#### The Expression Evaluator

The first high level language, FORTRAN. introduced the idea of an 'arithmetic expression' - a valid formula involving the usual operations of arithmetic and a range of functions - and of expression evaluation methods of reducing an expression down to a single value. Expressions and expression evaluation have now become so familiar to any high level language programmer that it is all too easy to take them for granted. Expressions and evaluation are, however almost the only opportunities that high level languages give programmers for changing

Nearly all versions of BASIC recognise the types of expression shown below.

- arithmetic expressions e.g. A+3\*SIN(X relational expressions e.g. A<>3 3. Boolean or logical expressions
  - e.g. A AND B string expressions e.g. A\$+"123"

The way that BASICs differ is in what data can be involved in each type of expression and how the types of expression can be mixed. For example, some versions of BASIC only allow Boolean expressions to involve the results of relational expressions. That is (A < B) AND (B=0) is valid but A AND B is not. ZX BASIC selects its data values and data types to make it possible to mix expressions as freely as possible. In particular, arithmetic expressions do not distinguish between integer and real values although a special representation is automatically used for integers for reasons of efficiency. Relational expressions can involve both arithmetic expressions and string expressions although it obviously makes no sense to compare a string to a

Mike James recently realised that, while he liked ZX BASIC, he rarely owned up to the fact in 'respectable' company. Here he sets the record straight by pointing out how logical and straightforward the Sinclair dialect of BASIC is.

own limited implementations that served to sell machines but were not really suitable for writing programs. When Microsoft BASIC became available on a range of microprocessors, and in a ROM form on machines such as the APPLE, the PET and the TRS-80 Model I, it was received with enthusiasm. It was powerful enough to allow useful programs to be written while being compact enough not to occupy too much memory and it set the standard for a minimum BASIC.

It is very easy to underestimate the success of Microsoft BASIC by assuming that BASICs like APPLESOFT, PET BASIC, TRS-80 BASIC, Atari BASIC, Dragon and Tandy Color BASIC are all different when in fact they are all customised versions of Microsoft BASIC in various stages of development. Dialects of BASIC that came after Microsoft BASIC usually carry a note to the effect that they are Microsoftcompatible or at the very least Microsoftlike. This has restricted new dialects of BASIC to extensions of Microsoft BASIC. In some ways this is an advantage in that it means that programs are more portable but it also means that any early design mistakes in the language are fixed forever.

ZX BASIC is the one dialect that has

computing would be limited to moving data from one place to another. In some senses the power and ease of use of a language come from the range of data and operations that can be combined together to form expressions and the absence of restrictions on where you can use such expressions. An ideal dialect of BASIC would allow all types of data and all types of operation to be

expression is an integer - 0 for false and 1 for true. Boolean expressions can involve any other expression that evaluates to a number. In this case 0 represents false and any other positive value (including 1) represents true. ZX BASIC is distinct in the way that it implements its Boolean operations on values other than 0 and 1 in that it treats the right and left hand values differently. This is shown below.

x AND y evaluates to x if y is true (i.e. y<>)

and

x OR y

0 if y is false (i.e. y=0)

evaluates to 1 if y is true (i.e. y <> 0) x if y is false (i.e. y=0)

combined whenever it made sense. In fact it is not quite as simple as this in that this requirement can easily be met by claiming that all but the most obvious operations are nonsensical. For example, what does -

#### 3+(2>0)

mean? It would be all too easy for the author of a dialect of BASIC to save time and trouble by ruling that such an expression is nonsense. In ZX BASIC (and in later versions of Microsoft) though such expressions are quite valid because the result of any relation is a number which represents one of the two possible results - ie true or false. In ZX BASIC true is represented by 1 and false is represented by 0 so evaluating the above expression gives 4.

Notice the way that the value of x effects the result in a different way to the value of y. If you are familiar with the more usual 'bitwise' logical operations of other versions of BASIC this strange way of interpreting AND and OR may seem of little use. Other versions of BASIC make their logical operators available for 'bit manipulation' by applying the operation to each pair of bits in the binary representation of values involved. That is for most versions of BASIC

#### 4 OR 2

evaluates to 6 because 4 is 100 in binary and 2 is 010 and 0Ring these together gives 110 or 6. However, in ZX BASIC -

4 OR 2

is 1. This inability to do bit manipulation is very important if you are interested in controlling hardware etc and at first sight the strange way that ZX BASIC handled Boolean operations on values other than 0 and I was a failing. Most BASIC programmers are however not concerned with bit manipulation (readers of E&CM are possible the exception in this!) and on closer examination ZX BASIC does provide something else of use to them. The result of evaluating AND could be written -

x AND y = IF y THEN x ELSE 0and similarly

x OR y = IF y THEN 1 ELSE x

Notice that both of these definitions do give

the correct answer for AND and OR if x and y are restricted to 0 and 1. In this sense they are just as valid as the more familiar bitwise operations. When written in the IF .. THEN .. ELSE form it should be easy to see what service they can provide the BASIC programmer with. For example, in ZX BASIC you can write expressions such

COST = TIME\*(RATE AND R\$= "STD") + TIME\*(HIRATE AND R\$= "PEAK")

If R\$="STD" then the first bracket works out to RATE and the second bracket works out to 0 making the whole expression evaluate to TIME\*RATE. However, if R\$="PEAK" then the first bracket is 0 and the second bracket is HIRATE making the whole expression TIME\*HIRATE. In other words if you have two mutually exclusive calculations then you can combine them into one 'conditional arithmetic expression'. OR can be used in a similar way. It is possible to write conditional arithmetic expressions using other versions of BASIC but ZX BASIC seems to encourage them, so extending the idea of an expression to include conditionals.

It is equally surprising to discover that for one Boolean operator, AND, the range of data and results extend to strings. In ZX BASIC X\$ AND Y will evaluate to X\$ if Y is true (ie any non-zero value) and to the null string if Y is false (ie zero). You can see that this is a logical extension of the way that AND normally works, with string values playing the role of true and the null string playing the role of false. String expressions can also be mixed with arithmetic expressions by use of the VAL function, which changes a string of digits into a number. Finally arithmetic expressions can be mixed with string expressions by the use of the STR\$ function which converts a number to a string of digits. (Functions like VAL and STR\$ that convert one data type to another are usually called transfer functions).

All in all ZX BASIC goes out of its way to try to allow as much calculation and data manipulation to be combined in a single expression as possible.

#### Using Expressions

ZX BASIC first begins to show its lack of restriction in the use of expressions. An ideal BASIC would follow the principle that anywhere that you can use a constant you should be allowed to use an expression of the same type. After all what is a constant other than the simplest form of an expression? However, you would be surprised how many versions of BASIC break this rule in some way or other. In most cases these restrictions are simply the result of sloppy interpreter design, in others there has been a genuine attempt to prohibit bad practice. In ZX BASIC the rule is applied almost without exception. For example, it is well known to ZX BASIC programmers that the general form of the GOTO and GOSUB instructions

GOTO expression GOSUB expression

so statements like -

#### GOTO INT(RND\*10)

are quite reasonable in ZX BASIC! It is usually claimed that the main reason that ZX BASIC allows expressions in GOTOs and GOSUBs is to make up for its lack of ON . . GOTO and ON . . GOSUB instructions. This is certainly true but it also allows you to write instructions like

#### **GOSUB PRINTOUT**

where PRINTOUT is a variable that contains the line number of a subroutine that prints something out. Apart from problems it creates for renumbering, this technique does improve the readability of programs and could be used more often.

A second and slightly less well known example of how ZX BASIC allows expressions to be used freely is provided by the INPUT statement. To input a value ZX BASIC uses the whole of its powers of expression evaluation. For example, if yuou try the following simple program -

10 INPUT A 20 PRINT A 30 GOTO 10

and enter 2\*2 in response to the INPUT you might be surprised to find that this expression is evaluated and 4 is printed by line 20. This can be a very useful feature. For example, when using a technical program, you could enter data with a multiplier to convert the data to the correct units. However, just think of the trouble that it could cause in a program that is trying to teach arithmetic - the user could short circuit the learning process and score 100% by typing the questions back in! An even more potentially dangerous problem, if you are not aware of it, is illustrated by adding -

#### 5 B=10

to the program above. Now if you enter something like B\*2 in response to the INPUT prompt you will discover that expression evaluation extends to looking up the current value of B! This is extremely useful when testing a program but can lead to disastrous consequences if the user keys in a variable name by accident. The same full expression evaluation is applied to the INPUT of string data. Once you know about this facility it is not difficult to find ways of actually making use of it.

The only two places that I know of where ZX BASIC treats constants and expressions on a different footing are BASIC line numbers and the BIN function. (The BIN function is only found in the Spectrum version of ZX BASIC). It is possible to imagine a system where line numbers could be specified by expressions but I think that there are easier ways of going about things! The function BIN, however, falls into a different category because it would be useful to be able to use BIN to convert binary expressions to decimal. However, ZX BASIC expressions do not include binary numbers as a data type and so the BIN function is treated all on its own and can only he used with constants

As well as using its expression evaluator every time a value is required, ZX BASIC also allows the programmer to use it. The function VAL(string expression) will evaluate any arithmetic expression contained in 'string expression'. So for example, you can tabulate a user supplied function using -

10 INPUT "Enter a function of X ";A\$
20 FOR X=0 TO 1 STEP,05
30 PRINT X,VAL(A\$)
40 NEXT X

This will print the value of any function for values of X in the range 0 to 1. You could enter SIN(X) or X\*\*2+X+3 and the VAL function would evaluate the expression each time through the loop using the current value of X.

Similarly, on the Spectrum the function VAL\$(string expression) will evaluate the string expression contained in 'string expression'! The VAL\$ function is just as easy to use as the VAL function but it tends to get a little confusing because of the way that the term string expression is used twice. For

VAL("2+2") will evaluate 2+2 (i.e. 4) VAL\$(""A"+""B""") will evaluate

The VAL\$ example looks very complicated because in ZX BASIC a quote must be written twice if it is inside another pair of quotes. If you remove the doubling quotes then the expression to be evaluated is simply "A"+"B". The VAL\$ function really only comes into its own when used to evaluate a string expression stored inside a string variable. For example,

A\$="X+2" VAL(A\$) will evaluate X+2

A\$="B\$+""S"" VALS(AS)

will evaluate B\$+"S". In other words, it will concatenate the current contents of B\$ with "S". The VAL\$ function is nowhere near as useful as the VAL function. However, it sometimes can come to the rescue in the most unlikely situations. For example, while writing a memory dump program I found that it was easy to find the names of all the string variables that a program had used but not their contents. However, once the name of a string is stored in A\$ its value can be obtained by VAL\$(A\$)!

#### ZX BASIC and Strings

Microsoft BASIC has set the standard for string handling by way of the functions LEFT\$, RIGHT\$ and MID\$. However, the whole idea of using functions to extract substrings is quite unnecessary. In ZX BASIC a string is treated as if it was a variable length array of characters—which is exactly what a string is. For example

A\$="ABCDEF" then A\$(1) is "A" and A\$(4) is "D"

This notation is familiar from standard numeric arrays. ZX BASIC also allows 'proper' arrays of characters to be defined—For example

#### 10 DIM B\$(10)

defines a one dimensional array B\$ consisting of exactly ten characters. Notice that the only difference between A\$ and B\$ is that B\$ is fixed in length. Assigning a single character to an array of characters or to a string is logically the same as assigning values to a numberic array. For example, both

A\$(2)="A" and B\$(5)="X"

assign characters to single elements of a string and a character array respectively. However, it is more convenient to assign a group of characters at a time and so the usual single element array assignment is extended to give the standard string assignment. So,

#### A\$="ABC"

is the same as

A\$(1)="A":A\$(2)="B":A\$(3)="c"

This extended form of assignment is where the difference between a string and a character array really shows itself. Firstly a string will accept any number of characters (up to a maximum of 255) and a character array will only accept the number of characters that it was dimensioned to accept. For example

#### A\$="ABC"

produces a string of three letters but

10 DIM B\$(10) 20 B\$="ABC" sets the first three characters of B\$ to ABC and the last seven to blanks. To assign values to a part of a string or a character array needs only another a small extension to the usual array index notation. For example,

#### A\$(3 TO 5)="ABCDEF"

will assign A to A\$(3), B to A\$(4) and C to A\$(5). This notation is called a 'slicer' and it can also be used to specify part of a string in other situations. For example,

#### 10 A\$="SPECTRUM" 20 PRINT A\$ (3 TO 5)

will print "ECT". Apart from a few extra notational conveniences, such as

A\$ (TO 3) meaning A\$(1 TO 3) and

A\$(3 TO) meaning A\$(3 TO LEN(A\$))

this is all there is to ZX BASIC string and character array handling. In many ways the use of slicers is a more direct way of specifying substrings, string elements etc. than the equivalent Microsoft functions MID\$, LEFT\$ and RIGHT\$.

Moving on to two and more dimensional character arrays is just as easy using the slicer notation although a slicer can only be used on the last index. So for example,

#### DIM A\$(10,10)

defines a 10 by 10 character array and A\$(3,3) is the third character in the third 'row'. Using the slicing notation you can specify substrings such as –

#### A\$93,4 TO 6)

which corresponds to character 4 to 6 in the third 'row'. Leaving the final slicer out is the same thing as specifying its maximum limits. That is A\$(3) is the same thing as A\$(3,1 TO 10).

ZX BASIC string handling brings out the relationship between strings, character

arrays and numeric arrays. The slicing notation is a more direct way of specifying substrings and it makes changing sections of existing strings particularly easy. For example, compare the clumsy and time-consuming

#### A\$=LEFT\$(A\$,2)+"XYZ"+ RIGHT\$(A\$,LEN(A\$)-5)

which is the Microsoft way of replacing the 3rd, 4th and 5th characters in A\$ with "XYZ" with the ZX BASIC -

#### A\$(3 TO 5)="XYZ"

#### Friendly And Versatile

In this short look at ZX BASIC the emphasis has naturally been on the few advanced or novel features that can be described in isolation. In use it is the way that these features fit together to give a friendly and economical language that makes ZX BASIC suitable for beginner and expert alike. There is also much to be said for the logic behind the Spectrum's parallel attribute graphics system and the way that ZX BASIC makes this available to the user. However, this is the sort of area where it is difficult to see how much praise should fall on the hardware designer for recognising just what is needed to produce colour graphics displays and how much to the software designer for making good use of what was provided. It's rather like trying to comment separately on the words and melody of a song and failing to notice that they fit together! There are plenty of features that I would like to see added to ZX BASIC, including an ON ERROR GOTO statement, a procedure call and local variables, but these would make ZX BASIC almost too big to fit into its current 16K ROM. Once again software and hardware interact! Seen as a whole ZX BASIC isn't perfect but it does deserve more praise than it currently gets.

E& CM (0 = FALSE 1 = TRUE) ARITHMETIC. EXPRESSIONS RELATIONAL **EXPRESSIONS** Figure 1. A diagramatic representation of the interaction (0 = FALSE 1 = TRUE) between various features of ZX BASIC. (0 = FALSE)\*BOOLEAN STRING **EXPRESSIONS EXPRESSIONS** (ONLY X\$ AND Y)

#### COMPUTER/ROBOTICS TRAINING

FULL-TIME COLLEGE COURSES

15 MONTHS **TEC Certificate in Computing Technology** 

9 MONTHS **TEC Higher Certificate in Computing Technology** 

(Shortened courses can be arranged for applicants with previous knowledge)

Subjects: Foundation Electronics, Digital Techniques, Micro-electronics, Microprocessors, Microcomputer based systems, Industrial Robotics, Hands-on Machine code and High Level programming, Fault diagnosis and ATE, plus in course project work.

Next course commences September 19th

Prospectus from:

ECM10

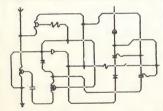
LONDON ELECTRONICS COLLEGE (Dept ECM) 20 Penywern Road, Earls Court, London SW5 9SU Tel: 01-373 8721

£ 9.95

ATARI	400 (16K/Inc. BASIC) 800 (48K/In. BASIC)	£129.00
SORD		
DRAGON	M5	£149.00
DIMOUN	32	£169.00
ORIC 1	401/	0400.00
SINCLAIR	48K	£139.00
	Sprectrum from	£99.00
COMMOD		C120.00
	VIC 20 Package	£139.00
SHARP		
	MZ80A MZ80B	
EPSON		
	HX20 Portable	
AOUARIUS	QX10	£ 1995.UU
	Colour Computer	£79.95
MIRACLE	Z80 CPM 128K Portable	\$2084 NO
	All prices include VAT	22007.00
	7111 priodo mondo 4711	

24 GLOUCESTER ROAD BRIGHTON 698424 ECM10

DIGITAL CIRCUIT DESIGNER



Ever spent hours drawing a circuit diagram, transferring it to a breadboard, burning out a few components and having to start again? Laborious, expensive and infuriating? Not any more! Electronics allows you to draw your circuit diagram on screen using standard symbols for logic gates, transistors, resistors, capacitors, diacs, triacs, diodes, etc, etc... Symbols can be rotated, wiring interconnected or crossed over as required. Once complete the computer will 'power up' your circuit - high voltage levels turn red, low levels turn green. Circuits can be de-activated, modified and re-activated until they function as required, all without touching a soldering iron! Part completed circuits may be saved for future work and displays can be sent to the printer. All components are fully interactive i.e. they can change the state of sections previously activated in the sequence - even oscillators can be seen oscillating. Warning is given of short-circuits. (57 defined graphics are employed)

INVESTA	MENT MUNITUR	2 0.93
40 % 200 da 30 %	Gold ys	
RISE 20 %		11111
10 % START	18 8 8 1	
PRICE		
-20 %		
FALL -40 %		

#### **48 K SPECTRUM**

**ENFIELD HOUSE SWARDESTON** NORWICH NORFOLK



These programs are exceptionally User friendly and have all been written in consultation with professionals in the respective fields. They are all fully menu driven, come with comprehensive written instructions and are fully guaranteed. Prices include surface postage worldwide - overseas customers requiring airmail please add 10%.

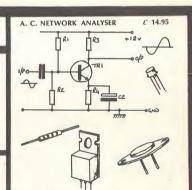
Dealer enquiries welcomed.



Nutrion is far more than a diet book! Builds up a personal profile based on individual characteristics and lifestyle then monitors food intake. It warns of any potential shortages of any of the essential nutrients, offers advice on suitable foods to restore the balance, advises on your ideal weight, calorie and nutritional requirements and can offer detailed information on the exact amounts of 23 essential nutrients, including calories, contained in 275 different foods. It can be used to plan balanced meals in advance and can operate in both metric and imperial units. Designed to be exceptionally User friendly it can be operated easily by all members of the family.

Shares continuously monitors up to 20 shares/investments with prices entered on a daily basis. Will display holdings, original and current prices, percentage fluctuations, annual equivelants plus performance graphs for the previous 12 days, 200 days or full year. Automatically updates itself after one year.

Numeric can solve or draw graphs of any formula with a single unknown which can be entered via the keyboard. Graph axes can be varied or reversed to suit individual functions. Solves Right Angle Triangles, Simultaneous and Quadratic Equations, Arithmetic Mean, Standard Deviation and Coefficient of Correlation between lists plus Deviation Curves.



Linnet does for a.c. networks what Electronics does for digital ones! Input characteristics of complete networks, including sub-circuits, are entered. The computer performs either time or frequency domain analyses, presenting the output data in any of a choice of forms, both graphical and written. The program detects the presence of a printer and, if connected, can produce detailed graphical displays by printing lengthways along the paper. Happily deals with highly complex networks - the instruction book provides numerous examples using transistors, I.C.s., bandpass filters, op amps, etc, etc... An invaluable tool for both professional and amateur designers.

MATHS TOOLKIT 2.26 13.6 34.1 34.1 13.6 2.28 9.78 0.52-0.26 14.7 23.9 33.0 42.2 51.4 60.5 69
TYPE 'M' FOR MORE, 'X' TO RETURN
OR 'P' FOR A PRINTED COPY

#### MICRO GRAPHICS TECHNIQUES



Mike James begins a new series that will explore the world of computer animation. Whether your interest lies in CAD or in games the principles developed during the series should enhance your program's output. This month – Sprites, the elements of animation.

The fact that micro computers have brought to graphics the status of a popular pastime is obvious. Historically graphics have either been taken very seriously, as in computer aided design, or have been treated as a source of fun, as in computer games. For the future it is becoming clear that graphics are going to play a much more central role in the use of computers. The new operating systems and applications software on machines like Apple's new Lisa interact with the user almost exclusively through graphics. Some of the problems of the high cost of good quality graphics hardware are going to be solved by the new 16-bit and 32 bit micros just coming off the production lines and drawing boards. However, even though graphics are so important, and despite the fact that a lot of programmer time and attention has been devoted to the subject, it is still not easy to see how the whole area is anything more than a collection of special techniques.

In this series of articles the objective will be to present the ideas and techniques underlying graphics on a small machine. The trouble with small machines is that they lack the computing power necessary to carry out the complicated calculations often involved in grapics in a reasonable amount of time. Very often even moving the requisite amount of data from one place to another can be too much for a micro! These difficulties have to be seen as something of a contradiction when even the lowest cost micro has high resolution colour graphics that not so long ago would have cost a small fortune. The result is that even if you resort to assembly language programming it is still rather more difficult to produce effective graphics than manufacturers' literature and hardware specifications might lead you to believe. Currently micro graphics is a mixture of theory and special go faster' tricks based on everything from using the hardware in ways that was never intended to fooling the viewer using a little simple psychology!

It would be possible to start a series on graphics by explaining the mathematical theory that lies behind 2D or 3D representations of objects or screens but it would take some time before anything practical or rewarding was achieved. So to kick off with something more immediately useful, this first part of the series looks at the theory and practice, of animation or Micky Mouse' graphics as it is sometimes called. Although the ideas and methods described throughout the series can be used on any micro with reasonable graphics facilities it is impossible to avoid being machine specific in some cases. The machines that will be specifically kept in mind during explanations and examples are the Spectrum, the BBC Micro/Electron and the Dragon/Tandy Color.

#### **Small Shapes**

It is worth making the distinction between large scale shapes drawn using lines, circles and colour filling instructions from small scale shapes. Small scale shapes are produced using a small number – generally less than a hundred – of display points or 'pixels' (short for 'picture elements'). The fact that so few points are involved means that it is possible simply to 'quote' the shape at any location where it is needed. The number of points involved in a large shape usually makes it worth replotting it using commands that draw lines, circles etc. every time it is needed.

Small shapes are so important that most computers provide special ways of quoting them. In most cases this is just an extension of the method used to print text characters on the screen to include user-definable graphics characters (eg Spectrum and BBC Micro). However, it is important to realise that user-definable characters form just one way to produce small graphics shapes. For example, the Dragon and the Tandy Color use two extra commands, GET and PUT, to define and reproduce small shapes. The GET command will store the dot pattern of any part of the screen in an array and the PUT command will transfer it back to any location.

The disadvantage of thinking about small shapes as the same as text characters is that there is a tendency to use them with the same set of restrictions. For example, it is common to print text only at a fixed number of locations on the screen, the so called 'character locations', but it is better to be able to print small shapes anywhere on the screen. The Spectrum, for example, will allow you to define any shape that you like within an 8 by 8 square of pixels but you can only print this shape into one of the 32 columns by 22 lines normally used for text characters. (This is in fact a software limitation rather than anything to do with the hardware!). The BBC Micro, however, allows the same 8 by 8 character block to be printed anywhere in the high resolution screen.

Whatever method a computer uses to produce small shapes, they have two main uses. The first is to fill the screen with multiple copies of a shape – for example, you could define the shape of a house and produce a small town by printing it in different places and colours, and the second is in animation. For both applications the important factor is speed. It is very important that whatever computer you are using for graphics it must be able to produce small shapes very fast for many applications this is a more important feature than good high resolution graphics commands.

Before leaving the subject of small shapes it is worth mentioning the way that the remarkable Atari range of personal computers deal with small shapes. In most computers the definition of a user-defined character is held in memory and every time you print the character the machine transfers the pattern of pixels to the screen RAM, which is of course a different area of memory. In this way printing (or in the Dragon's case PUTting) a small shape is simply a matter of transferring the bits that represent the dot pattern from one area of memory to another. This means that once a character is printed you can change its definition without changing anything that is already on the screen.

The Atari however takes a completely different approach. The definition of a user-defined character is held in memory in the usual way but instead of transferring the pixel pattern to another area of memory when it is printed the Atari simply transfers a character code which indicates which character is to be displayed. This code is used to look up a character definition each time that the screen is displayed. So if you change the definition of the character then all the existing examples of it already on the screen instantly change their shape! This can obviously be used to produce internal movement in a small shape, but more of this later.

#### **Blanking Animation**

The standard method of making things move in a computer display is fairly well known even to novice programmers. To move a shape on the screen you first draw it at one location, then remove it or 'blank' it out, only to redraw it slightly shifted. The smoothness of the apparent motion produced by this blanking animation depends on a number of interacting factors. The following guidelines should aid the production of smooth movement.

The distance moved at each step should be small.

the time taken to blank and produce the shape should also be small.

The shape should be displayed on the screen for as long as possible between moves.

For really smooth motion each step should be synchronised with the TV frame display rate.

The perceived smoothness is also affected by the shape, colour and texture of the object.

The trouble is that in practice most micros are too slow to produce smooth animation using BASIC. Even using assembler, a great deal of care and attention is needed to produce a flicker-free screen. The problem increases as the number of separate objects being moved increases. Normally animation graphics are developed in a haphazard way, with each moving object being added to the program in turn perhaps even using a completely different method for each. However, there is a way of organising the animation of any number of small shapes that is entirely systematic.

#### Sprites

Once you start writing animation programs you soon learn that the best way to think of the path that a moving object takes is by using the idea of velocities. For example, if an object is moving smoothly in a straight line across the screen it can be associated with four quantities—

X - its present x co-ordinate
Y - its present y co-ordinate
XV - its x or horizontal velocity
YV - its y or vertical velocity

In other words at any given point in the program the object is at the position X,Y and its next position will be X+XV,Y+YV. The use of velocities makes it particularly easy to update the current position to give the new position using nothing but addition – which should be one of the fastest operations that a micro can perform. In practice moving an object about the screen rarely involves nothing but motion in a straight line! Fortunately it is not difficult to extend the use of velocities to produce all types of movement.

A small graphics shape together with its current position and a pair of velocities is usually called a 'sprite'. (They are also known as 'MOBs' standing for 'Movable OBjects'). This sort of sprite is in fact the simplest used in animated graphics and in practice the idea is elaborated considerably. Sprites are often associated with special graphics hardware that will automatically update positions and plot the shape on the screen. However, while sprite hardware does make things easier and faster, software sprites are also useful in writing programs on any machine.

#### Acceleration

Before giving an example of how sprites can be used it is necessary to add the idea of acceleration. As already noted it is rare that objects move smoothly in straight lines. For one thing they tend to go off the edge of the screen! In practice objects move across the screen changing their velocity, sometimes continuously as in the case of a ball or a lunar lander 'falling' in an arc down the screen, and sometimes suddenly as in the case of an object 'bouncing' off the sides of the screen. However, the common factor is that the velocity does change and a change in velocity is usually called an 'acceleration'. This suggests that to make sprites really useful the number of quantities associated with a sprite should be increased to six by

adding a horizontal and a vertical acceleration. —XA and YA. Now at each stage the current position is updated by

$$X = X + XV$$
and
$$Y = Y + YV$$
and the velocities by
$$XV = XV + XA$$
and
$$YV = YV + YA$$

This method does indeed work for movements that involve smooth changes in an object's velocity but what about the sudden changes involved in an object 'bouncing' off another object? To take this sort of sudden change into account we have to introduce yet another idea—that of a 'force function'. A force function defines the way that the accelerations depend on the current position, the current velocity, the current acceleration and any other conditions that you might want to take into account! It is easier to understand the way that a force function controls the movement of a sprite by looking at an example. But first it is worth summarising the definition of a simple sprite. A sprite is composed of the following information—

- 1 The shape of the object
- 2 The current position stored in X and Y
- 3-The accelerations XA and YA
- 4 The force function that is used to update accelerations

#### Sprite Example

Consider the well known problem of bouncing a ball around the screen in terms of sprites – except that to show the advantages of sprites consider bouncing more than one ball around the screen. In fact the program given below will bounce any number of balls around the screen if you don't worry about how fast (or rather slow) everyting moves!

The first part of constructing the program involves defining a suitable sprite for the bouncing ball. The shape of the ball is easily solved and we can assume that it is stored in the string S\$. In other words, PRINT S\$ produces the ball shape on the screen. Its current position can be stored in X and Y and its current velocity in XV and YV. The problems really only start when you try to work out what the acceleration should be. When the ball is moving about the screen away from the wall the answer is easy – both horizontal and vertical acceleration are 0. However, when the ball is near, or to be more accurate touching, the edge of the screen the acceleration is clearly not zero because the one of the ball's velocities will be reversed to create the bounce. If the ball meets a horizontal wall then YV is changed to —YV, if it meets vertical wall then XV is changed to —XV. In terms of acceleration this implies –

IF the ball is in contact with a horizontal wall THEN
YA=-2\*YV ELSE YA=0
IF the ball is in contact with a vertical wall THEN

If the ball is in contact with a vertical wall THEN XA=—2\*XV ELSE XA=0

To turn these two IF statements completely into BASIC only requires the test for horizontal and vertical walls to be made exact. If we consider that the screen co-ordinates go from 0 to 31 horizontally and 0 to 15 vertically then the tests can be written –

IF Y=0 OR Y=15 THEN YA=-2\*YV ELSE YA=0
IF X=0 OR Y=31 THEN XA=-2\*XV ELSE XA=0

You should recognise these two IF statements as the force function for the ball because together they determine the acceleration at each update.

Now all that remains is to put all of the parts of the sprite together to produce the program. However, the whole point about using sprites is that once you have defined a sprite for an object it is easy to re-use the definition to produce any number of examples of the sprite moving around the screen. All that you have to do is to replace each of the

variables associated with the sprite by an array large enough to hold the information for each sprite. For example, if you want five balls bouncing round the screen the use X(5) to record the current x coordinate of each sprite -X(1) is the x co-ordinate of the first example of the sprite, X(2) the x co-ordinate of the second and so on. The resulting program for the BBC micro or Electron is shown in Program 1.

10 GOSUB 1000 2080 YV(I)=SGN/RND(I)~,5) 10 GOSUB 1000
20 PRINT "How many sprites";
30 INPUT N
40 DIM S\$(N),X(N),Y(N),XV(N),YV(N)
,YA(N),YA(N) 2090 YA(I)=0 2090 XA(I)=0 2100 YA(I)=0 2110 NEXT I 2120 EFTURN 50 DIM PX(N), PY(N) 50 GOSUB 1000 70 GOSUB 2000 80 GOSUB 3000 90 GOTO 80 3010 PX(I)=X(I) 3070 PY(I)=Y(I) 3030 Y(I)=X(I)+XV(I) 3040 Y(I)=Y(I)\*YV(I) 3040 YTH=Y(H=YV(I) 3050 IF X(I)=0 OR X(I)=31 THEN XA(I)=-2\*XV(I) ELSE XA(I)=0 3060 IF Y(I)=0 OR Y(I)=15 THEN YA(I)= 2\*YV(I) ELSE YA(I)=0 3070 XV(I)=XV(I)+XA(I) 3080 YV(I)=YV(I)+YA(I) 3090 PENET TAB(IX(I),\*Y(I));""; 3100 PENET TAB(IX(I),\*Y(I)); 1000 MODE 6 1010 RETURN 2000 GOSUB 6000 2000 GOSUB 6000 2010 FOR I=1 TO N 2020 S\$(I)=CHP\$(240) 2030 X(I)=INT(RND(0)\*30)+1 2040 Y(I)=INT(RND(11\*14)+1 2050 PX(I)=X(I) 3120 NEXT I 3120 RETURN A000 VDU 23,240,8FF,8FF,8FF,8FF,8FF,8FF,8FF,8FF 2070 XV(I)=SGN(RND(I)-,5) PROGRAM 1

Subroutine 1000 clears the screen. Subroutine 2000 sets initial values for each of the sprites variables. Random values are used for the initial positions and velocities. Subroutine 3000 carries out the updating of position, velocity and acceleration. Subroutine 6000 sets the shape of the small solid object.

On the BBC Micro the program can animate around five balls without too much loss of speed and the resulting display is quite impressive. Users of the Spectrum and the Dragon should have no difficulty in converting the program because none of the extra special features of the BBC Micro have been used but the number of balls that can be bounced is likely to be fewer than five. Spectrum users should change the PRINT TAB to PRINT AT and Dragon users should use PRINT @ in the usual way.

The power of the sprite method of organising animation programs should be clear from the economy and simplicity of the above program. However, the sprite method also leads to programs that are easy to modify. For example, if you want to add some 'gravity' to the bouncing balls so that they fall in a parabolic arc and then bounce back up to the same height change line 3060 to -

3060 IF INT  $(Y(I)) \le 0$  OR INT $(Y(I)) \ge 15$  THEN YA(I) = -2\*YV ELSE YA(I) = .1

Apart from changing the tests for a collision with the boundary to take account of the fact that Y(I) may be fractional, the main change is to set the vertical acceleration to a small constant to mimic the effect of gravity.

Other changes are equally simple. For example, if you want to make the balls bounce less each time change line 3060 to-

3060 IF INT  $(Y(I)) \le 0$  OR INT(Y(I)) > 15 THEN YA(I) =-1.99\*YV ELSE YA(I)=.1

where the 1.99\*YV reflects a reduction in the vertical velocity on each (horizontal) bounce). You could make each of the sprites have a different shape by changing subroutine 2000 where S\$ is defined. You could even attach a colour code, a sound to be produced at each bounce etc. to the sprites.

#### Priorities, Collisions And Events

You may be thinking that bouncing balls around the screen is hardly a job of work by which to test the usefulness of the sprite idea. However, once you start exploring some of the additional ideas that suggest themselves and seem natural when you work with sprites it becomes difficult to believe that you ever thought about animation in any other way! For example, the order in which you blank and draw sprites imposes a natural priority on a collection of sprites. A later sprite will appear to pass in front of an earlier sprite if they both happen to reach

the same screen position. This is simply because the later sprite will overwrite the earlier one but it leads to a way of ordering sprites so that when they meet you can predict what the result will look like. The idea of one sprite passing over another one leads naturally on to the idea of sprite-sprite collisions. At the end of all sprite moves it is easy (but time consuming in BASIC) to check to see if any of the sprites are in the same position and so have collided. A sprite collision is usually dealt with by a special subroutine. for example, if one of the sprites is a rocket and the other a target then when a sprite-sprite collision is detected the obvious thing to do is to call a subroutine that produces an explosion! This idea of a collision causing something different to happen within the program is very like what happens during a hardware interrupt. Interrupts are normally used to inform the computer that something unusual or important that needs special attention has happened in the outside world. This is exactly what happens with a sprite collision except that the event is internal.

The idea can be generalised to sprite events which correspond to any detectable condition that should cause the program to do something different. For example, the sprite bounce from the boundary wall that was controlled by the force function could have been declared a sprite event that when detected called a subroutine that reversed the velocity and perhaps made a noise. There is often more than one way to animate a sprite and the number of ways increases as the idea of a sprite becomes more and more elaborate. Some of these ideas will be treated later in the series but there is a lot to be gained from trying to keep sprites simple - especially in BASIC!

#### Without Going Anywhere

You may already be trying to think of examples of moving graphics that you have seen that would be difficult to implement using sprites. The majority of animated displays are not difficult to interpret in terms of nothing but sprite graphics once you have had a little practice. For example, consider the traditional space invaders screen with alien ships in rows moving from side to side and then slowly moving down the screen. How can this almost static movement be translated into sprites? The answer is surprisingly easy! Change the following lines in the original bouncing balls program -

2030 X(I)=I\*3 2040 Y(I)=1 2050 XV(I)=2 2060 YV(I)=.1 3050 XA(I) = -2\*XV(I)

The only changes are to the initial positions and velocities of the shapes and to the force formula. The initial positions are set to produce a single row of shapes by line 2030 and 2040. Line 2050 sets a horizontal velocity of 2 and a vertical velocity of .1. As you might expect, this results in a large sideways velocity but a very small vertical velocity making the row creep forward. Line 3050 is responsible for the side to side oscillation because it reverses the velocity at each update. You should now be able to see how this method could be extended to more than one row and how to make the 'ships' move faster down the screen as the game progresses without having to use a single non-sprite idea!

#### Conclusion

The main topic of this first part of Micro Graphics has been the sprite. This powerful animation method provides a good theoretical background to use when constructing programs. However, from BASIC a program that is constructed using sprites will often run too slowly to produce a good effect. In this situation there is no choice but to resort to 'dirty tricks'. The bouncing balls program can be made to go faster by tackling the problem directly but even then there is something to be gained from using sprites in the design stage. However, if you are using assembly language then sprites are an ideal method of organising and implementing your program.

Next Month - Sprites make a second appearance when small moving shapes also change their shape as they move, crash into other shapes and generally explode! E& CM

# The Plug says No to dirty power.

WARNING: Unfiltered power can damage your computer's health.

Because dirty power is the most likely cause of the unexplained errors and circuit malfunctions which can upset all micro based products and their users.

The Plug with its own built in filter and transient suppressor reduces the effect of electrical noise and spikes and increases the reliability of both hardware and software.

Protect your computer from unnecessary power problems, say 'No' to dirty power.



The Plug is available from dealers or direct from the manufacturer

FOR FURTHER INFORMATION CONTACT:

Power International Limited 2A Isambard Brunel Road, Portsmouth, Hampshire. PO1 2DU. Tel. (0705) 756715



programme. Latest electronics and top software allow you to draw fine, medium or thick lines or use the pen like

With a superb programme written by a leading school computer lecturer. Accurate, colourful and with powerful commands - ready to plug in and use.



RS232 Standard

Complies with B.T. Spec.

All Europe accessability

Full Duplex

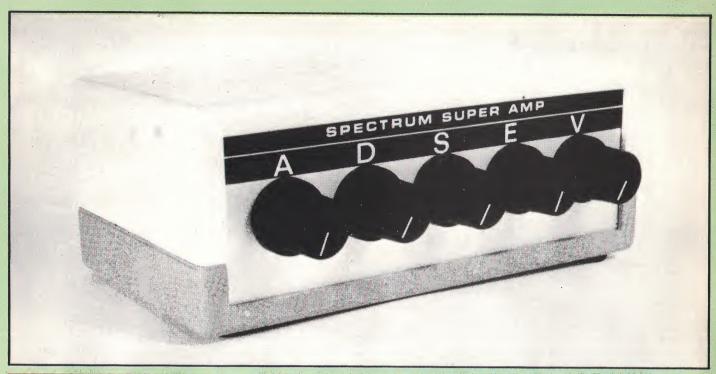
FOR BBC 'B' Ready to plug in and use FOR ZX81/SPECTRUM Requires Interface £29.95 FOR VIC 20/DRAGON Requires Interface £24.95

**IPSWICH** IP4 2BR

OFFICIAL ORDERS

Tel: Sales 0473-50304 Tech. 0449-721888 NAME & ADDRESS

	NAME & ADDITEOU	
		Make of computer
-	MODEM £69.95 + £2.22 p&p + £10.83 VAT	£83.00
_	Interface ZX81/SPECTRUM £29.95 + £1.14 p&p + £4.66 VAT	£35.75
-	Interface VIC 20/DRAGON £24.95 + £1.14 p&p + £3.91 VAT	£30.00
	LIGHT PEN £12.95 + p&p + £2.03 VAT	£15.60
	GRAPHIC DIGITIZER £29.95 + £1.35 p&p + £4.70 VAT	£36.00
	BARCLAYCARD/ACCESS No. Or Cheque Enc.	TOTAL



#### SPECTRUM EFFECTS UNIT

This project uses some cunning circuitry to vastly enhance the Spectrum's BEEP sound command. It also incorporates an amplifier capable of filling a room with the resultant effects. Mark Stuart describes the design.

The Spectrum Sound Board project published in our August and September issues showed one of the ways in which the Spectrum's sound generating capability could be enhanced. The effects unit described here shows an alternative approach that has the advantage of being both easy to use and capable of producing a wide range of interesting effects far removed from the underlying 'beep'.

Five controls are provided on the unit, these being a volume control, and four effects controls which modify the envelope of the sound. Three of the effects controls set the 'attack', 'sustain', and 'decay' characteristics of the sound. A fast attach and slow decay setting gives a percussive sound while an envelope with a slow attack and short decay sounds more like a wind instrument. The Sustain control determines the duration of the sound, from the start of the attack period to the start of the decay period. The three envelope controls allow the sound to be modified over a very wide range, producing excellent sound effects for games, or musical applications.

The fourth effect control governs the echo effect that is produced by interrupting the output at a rate set by the control. The echo effect can be turned off using a switch on the echo control.

In order to keep the amplifier as easy as possible to use, it is powered by an internal PP3 battery. The only connection required is

from the Spectrum 'mic' socket to the amplifier input, using the tape input/output lead. For further simplicity the amplifier on/off switch is incorporated into its input jack socket. The power is switched on by inserting the input jack plug.

To enable a PP3 battery to have a good working life great care was taken to minimise standing current. In the absence of an input signal all the amplifier stages are biased off. A single CMOS IC is used to provide the switching functions.

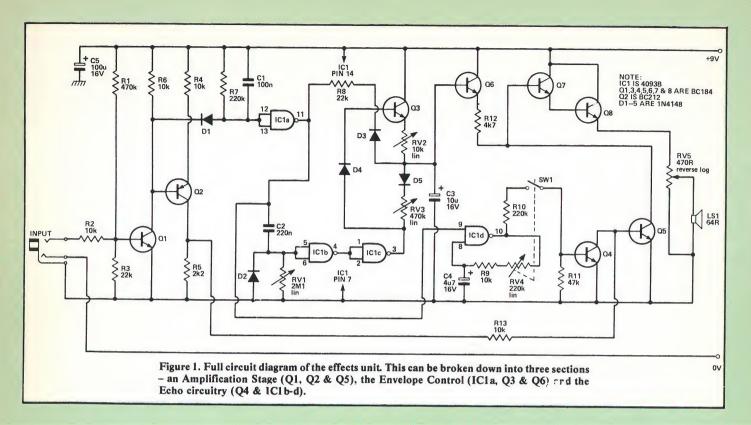
#### **Envelope Control**

As soon as an input signal is received the amplified output at Q1 collector is half wave rectified by D1 and smoothed by C1. The result is that the voltage on IC1a's input, which is normally held at the positive supply voltage by R7, falls sharply towards 0V and remains there for the duration of the input signal. IC1a is connected as an inverting Schmitt trigger and its output will normally be at 0V. When the voltage across R7 falls below half of the supply voltage, IC1a's output will immediately switch to 9V. Capacitor C2 couples the positive pulse from the output of IC1a to the input of IC1b.

The two inverting Schmitt triggers IC1b and c are connected together to form a non inverting Schmitt trigger circuit. Normally

IC1b's input is held low via RV1 and therefore IC1c's output is at 0 volts. When the output of IC1a switches to 9V, IC1b's input is also switched to 9V via C2. IC1b's output therefore falls to 0 volts and IC1c's output rises to 9V. C2 immediately starts charging via RV1 and the voltage at the input of IC1b falls towards zero. When IC1b input has fallen to approximately half supply voltage its output switches back to 9 volts, and IC1c's output returns to 0V. The length of time for which IC1c's output is at 9V is set by the values of C2 and RV1. This time, the 'sustain' period, is adjustable from zero to approximately 0.5 seconds by RV1.

During the sustain period the base of Q3 is held positive by IC1c's output via D4. C3 initially at 0V, charges via Q3 at a rate set by the attack control RV2. At the end of the sustain period when IC1c's output falls to 0 volts - Q3 is turned off, and C3 discharges via D5 at a rate set by the decay control RV3. The voltage on C3 is buffered by emitter follower Q6, and used to bias the collector load resistor of the output driver transistor Q5. The maximum positive swing of the output stage therefore depends on the voltage across C3 - the envelope control voltage. Whenever the signal from the Spectrum ceases, IC1 a's output falls to zero, C3 is discharged via R8 and D3, and the output stage is turned off.



#### The Amplifier

The Spectrum provides approximately 1 volt peak to peak audio output, from the 'mic' socket via a DC blocking capacitor. The output waveform is a square wave over most of the audio range, with a gradual low frequency roll off. Input transistor Q1 is biased by R1 and R3 to OV4 so that it is normally cut off. Positive half cycles of the input signal added to the bias voltage are

sufficient to turn Q1 fully on. Q1 collector swings from 9V down to nearly 0 volts during positive input half cycles, and back to 9 volts as Q1 is cut off during negative input half cycles.

Switching amplifier, Q2, buffers and signal at Q1 collector and feeds output driver transistor, Q5. If the envelope circuitry (Q3, Q4 and IC1) is ignored for a moment Q6 can

be assumed to be turned on, R12 forms the collector load for Q5, the driver transistor. Output transistors Q7 and Q8 are connected as a darlington pair operating in emitter follower mode, driving the high level volume control RV5 and the loudspeaker. Maximum output is 7 volts peak to peak across the 64 ohm speaker, this is 200mW for a square wave signal.

#### **BUYER'S GUIDE**

We have arranged for Magenta Electronics to supply a complete kit of components for this project.

The price is £13.99 including VAT – postage and packing is 50p extra.

Magenta Electronics 135 Hunter Street Burton-on-Trent Staffs DE14 2ST

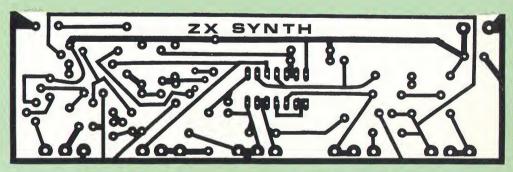


Figure 2. The full size foil pattern of the effects unit's PCB.

#### Assembly

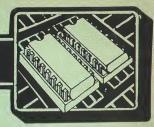
The whole circuit is built on a single printed circuit board. Refer to the printed circuit board overlay drawing, and insert and solder the components in the usual order – low profile components first, large components and wire leads last. Note in particular that Q1 must lie flat down to the board to leave room for the switched potentiometer RV4/SW1. Resistor R4 is fitted on end, and R10 is mounted between the board and SW1. Make sure that the electrolytic capacitors, diodes, transistors, and IC1 are

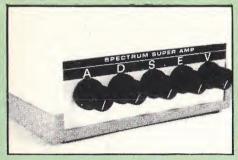
the right way round. A socket is recommended for CMOS IC1.

It is important to use the correct type of PCB mounting pots for RV1 – RV5. The assembled board is mounted to the case front panel by the potentiometer bushes. Jack socket SK1 is a switched type with a normally open contact on the sleeve terminal. Alternatively a standard jack socket and a separate toggle switch can be used, with the necessary wiring change. The prototype was built in a snap together verobox with slide in front and rear panels. The loudspeaker is glued inside the top half of the case.

#### Echo

The two Nand inputs of IC1d are used to control the echo effect. One input is connected to the output of IC1a while the other input along with C4, R9 and RV4, forms an inverting Schmitt trigger oscillator around IC1d. By using the two inputs in this way the oscillator section is switched on whenever an input signal from the computer is present. From IC1d's output the square wave oscillator's signal passes via R10 to the base of Q4. Positive half cycles from IC1d turn on Q4, and remove drive from Q5 base. The output is therefore interrupted at a rate





set by the echo control. The echo on-off switch disconnects the echo oscillator output from Q4 base when echo is not required.

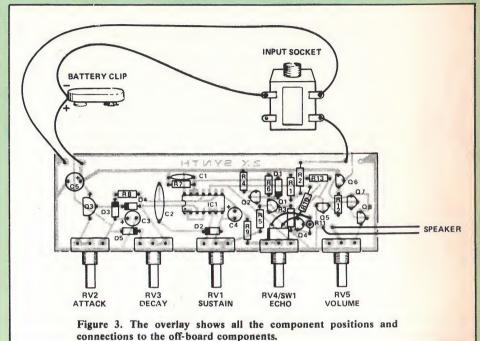
#### Testing

Fit a PP3 battery to the amplifier and connect the input to your Spectrum 'mic' socket, using the tape in-out lead. Turn the echo control off - set the attack, sustain and volume controls fully clockwise, and the decay control fully anticlockwise. Enter a simple 'Beep' command to produce a 4 second beep at about middle C. The output should be a loud beep that cuts off sharply after about half a second. Reduce the setting of the sustain control and the output beep should cut off in a shorter time. If the sustain control is moved to zero there will be no output because the Beep has been shortened so much that is disappears.

Next experiment with the deay control. Set the sustain to maximum and the decay control to halfway. Enter a four second beep - the output should die away steadily. Try different settings of the decay control to get some idea of the range of the control.

To check the attack control set the sustain and decay controls to half way and gradually turn back the attack control. As the attack control setting is reduced the rate of rise of the output signal should be heard to change, giving the sound a more 'gentle' characteristic. Note that the attack period takes place during the sustain time. If the sustain time is too short the output will not have time to rise to its full output before the decay commences.

To test the echo effect set the decay and sustain controls fully clockwise and enter a long beep. Switch on the echo and set the rate as required. At the higher speeds the echo becomes more like a second audio tone modulating the beep, giving some interesting musical, and not so musical, effects. Assuming everything works normally the unit is ready for use. Note that below about 50Hz the effects controls cease to operate. This is because each half cycle re-triggers the sustain circuit. This is a very minor limitation in practice since most applications use much higher frequencies. **E&CM** 





PARTS LIST	•	Capacitors		
		C1	100 n	
Posistors - 0 251	W 5% carbon film	C2	220 n	
R1	470K	C3	100 u	
		C4	4 u 7 u	
R2, 4, 6, 9, 13	10 K	C5	100 u	
R3, 8	22 K			
R5	2 K2	Semiconductors		
R7, 10	220 K	D1-5	IN4148	
R11	47 K	Q1, 3, 4, 5, 6, 7, 8	BC184	
R12	4 K7	Q2	BC212	
Potentiometers		IC1	4093B CMOS	
RV1	2M2 lin	Miscellaneous		
RV2	10K lin	64 ohm miniature	sneaker PCB	
RV3	470 K lin	3.5mm jack socket with 1 n/o contact,		
RV4/SW1	220K lin switched	F,		
RV5	470R reverse log	with marker line - 5	off, Connecting	
All pcb mounting	type 0.2" pin spacing	wire.		
		- Control of the Cont		

## HAVING TROUBLE OBTAINING QUALITY COMPUTER LENGTH CASSETTES? ...

#### JP MAGNETICS CAN SOLVE YOUR PROBLEM

10 × C.15 for £4.50 + 50p P&P CASH WITH ORDER

We are specialists in the supply of bulk custom wound audio/computer cassettes

#### EDUCATION & TRADE ENQUIRIES WELCOME

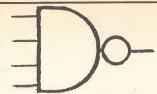
VERY COMPETITIVE RATES AVAILABLE

- CONTACT US FOR PRICE LIST/
QUOTATIONS NOW

0274.731651

#### JP MAGNETICS LTD

UNIT 4, 7 MARY ST, BRADFORD BD4 8SW TEL: (0274) 731651



COMPUTER
PERIPHERALS
from
ROSCO

SPECIAL OFFER ★



#### STAR DP510 - 80 COLUMN 100CPS PRINTER - £257

Also available at low prices:

EPSON FX80	£399
SMITH-CORONA TP-1	£427
JUKI 6100 DAISYWHEEL	£375
SANYO 12" MONITOR (GREEN DISPLAY)	£79
APPLE 2 COMPATIBLE DISC DRIVES	£167

p&p £8. Add 15% VAT to total order value.

For full details of all computer consumables and peripherals contact:

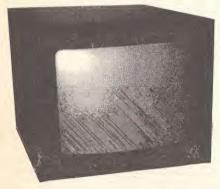
#### ROSCO LTD.

FREEPOST, BIRMINGHAM, B20 1BR Telephone: 021 356 7402

ECM10

#### **JLC Display Electronics**

#### **COLOUR MONITORS**



#### The 3000 Series



#### FOR DISPLAYS THINK JLC MONITORS

Superb Quality, Definition & Clarity: JLC Monitors enjoy a country-wide reputation in home, office, factory and institution.

Reliability: With 20 years experience JLC's specifically designed units incorporate "State of the art" technology. Compatibility: JLC Monitors are ideal with popular micro's, V.C.R.'s, TV cameras, Prestel Decoders including BBC/ACORN, DRAGON, ORIC, COMMODORE, R.H., TANTEL, etc.

Versatility: JLC Monitors are designed for a choice of applications and inputs. Composite Video, RGB (IV—75ohms), RGB (TTL), sound, structural foam cases, metal case or chassis only. What would you like?

Value: JLC Monitors range in price from £130 to £300. For a quality product complete with a low power consuming switch mode power supply, multicolour capability linear video amplifier, superb "Hi-Bri" tube with 0.63mm pitch.

Designed & Produced in England

UNIT 7, 551A HIGH ROAD, TOTTENHAM, LONDON N17 6SB. Tel: 01-808 8848

"OUR SIMPLIFIED CIRCUITRY FOR QUALITY AT LOW COST"
(OEM & DISTRIBUTOR ENQUIRIES WELCOME)

#### **PRINTERS**

#### This month Nick Clare has assembled details of a variety of printers covering a span of prices.

Of all the peripherals that most computer users purchase, printers, along with disc drives, are likely to require the largest capital outlay. In the case of disc drives, the price for a given amount of storage tends to be much the same no matter from whom the drive is purchased. In the case of printers however, the variation in price for what at first glance may seem models of much the same performance can vary greatly. Fundamentally though the old adage 'you get what you pay for' very much applies to the printer market.

As with most products in the computer market place, there are fundamental trade offs between various aspects of a printer's performance and between these and a particular model's price. One of the major trade offs is between a printer's speed and the quality of printout – the faster the printer the lower the quality. While this is generally true it is possible to identify slow printers with low quality output of Sinclair's ZX printer and to printers capable of almost letter

quality output at a fair speed.

A variety of techniques are used to produce a printed output from the very low cost thermal approach, through ribbons and hammers which form the basis of the vast majority of printers to daisy wheel printers at the top end of the market. With the exception of daisy wheels, most output is in the form of a matrix of dots and the number of dots that go to form the matrix play a vital part in determining the ultimate quality of the printed characters.

The other major aspect of a printers specification is the communication protocol adopted. Most printers in their base version will feature a centronics parallel interface – an RS232 option is usually available at a premium of about £40/£50.

#### Low Cost Models

The lowest cost printer, not surprisingly, is the Sinclair ZX printer. Much has been said about this printer—mostly about its slow speed and poor quality—and it is mentioned merely to get the ball rolling. The ZX printer also suffers from the disadvantages that, without a special interface, it can only be used with ZX81 or the Spectrum.

Another printer designed for the ZX computer is the **Dean Electronics** Alphacom 32. This printer uses thermal paper, as does the Sinclair printer, but uses a 4.5" wide roll that prints 32 characters per line at a rate of two lines per second. The printer features a seld test mode and a paper advance facility.

The Alphacom 32 costs £99.95 inclusive of VAT and postage and packing. One 25m roll of paper is also included in the price.

#### Forever Amber

At £89.70 plus £3.50 p&p, the Amber 2400 matrix printer is another low cost solution to the problem of hard copy output. This printer uses plain paper rolls and print hammers plus an ink ribbon. The output looks much the same as that produced by cash dispenser machines (not the pound notes but the acknowledgement slips!) being very legible if not elegant.

The printer provides both parallel and serial interfaces and Amber can supply connecting leads in order that the printer can be used with the BBC Micro, the Acorn Atom, the 101, the Dragon and Atari 400/800 as well as the New Brain. A who's who of the popular computers available at present and the company may be prepared to discuss interfaces for other machines.

#### **ALPS Mechanisms**

In the £100-£200 price range about the only printers to be found are based around the ALPS printer mechanism. Both the Oric and Tandy printers are built around the four colour printing/plotting unit. These printers are capable of producing reasonable quality text along with intricate graphic patterns.

The Tandy unit can successfully be used in conjunction with the

BBC micro as well as with Tandy's machines.

If the mixture of text and graphics is required, these printers are an ideal choice.

#### Above £200

Once the £200 barrier is broken, the choice of printers begins to widen considerably. The **Seikosha** range of printers, available from Intelligent Interfaces, have a VIC 20 graphics printer that just breaks the £200 barriers by £5 although VAT must be added to this price. It uses a uni-hammer printing method to produce a  $6 \times 7$  dot matrix. Printing speed is 30 char/sec and the maximum width is 80 columns.

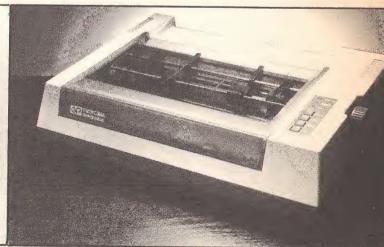
The GP-100A is a version of the VIC printer that features a standard centronics compatible interface (RS232 as an option). The

price of this printer is £215 plus VAT.

At £425 + VAT the GP-700A is another printer from Seikoshaa printer that can produce colour output. The added impact of colour output will be worth the extra cost in many applications that mix text with graphics or where various sections of text need to be highlighted.

Intellect interfaces also stock a range of other printers and their





price list (which includes a variety of cables and buffers) is worth obtaining.

Another source of low-cost dot matrix printers is **Geveke Electronics.** The range of printers from the Company includes the **GLII/GSII** 80 column/100 character per second model. This is a tractor feed printer that provides either serial or parallel interfaces. It incorporates a one line buffer and uses a nine needle print head to produce its output.

Geveke also supply a number of more expensive printers with the star of their range being the Diablo ink jet colour printer.

#### The Form Of Flattery

Some of the most imitated printers on the market are those produced by Epson. Norbain Micro Ltd. stock the two main stays of the Epson range – the RX80 at £298 plus VAT and The FX80 at £438 plus the VAT.

The FX80 follows established Epson design philosophy and incorporates a variety of type styles in ROM as well as RAM memory for storing up to 256 user defined characters or alternatively a 3K buffer.

The RX80 is a slimmed down version of the FX80 omitting such features as the in-built RAM.

Epson printers have a reputation for reliable operation – something that is of prime importance to many users – the E&CM office was brought to a halt when one printer went down recently.

Another range of printers worth consideration if a dot matrixs design is required are the models produced by Mannesman Tally.

These include the 80 column, 80 cps MT80 with dot addressable and line graphics through to the MT180 capable of producing 160 cps flat out which slows down to 40 cps when the machine is producing letter quality output.

The range is available from CK computers who also stock other ranges of printers.

Another good source of printers and accessories is **Thame Systems Ltd.** They stock a wide range of printers including models by Axiom, Brother, NEC and Toshiba. Looking through the Company's catalogue should reveal a printer to suit most applications.

If the ultimate quality is demanded from a printer and speed is not of the essence there can be no doubt that a daisy wheel printer is the best choice. You have to pay for the quality though and may well have to spend in excess of £1000.

If this sort of printer is what you require APT can help with a range of sophisticated high quality printers.

#### See Before Buying

With printers, more than most peripherals, its a good idea to see the printer in action before making a purchase. Print quality, noise levels and speed are all major factors in choosing a printer and are best assessed by observing the machine in action.

Dean Electronics Glendale Park Fernbank Road Ascot Berkshire Geveke Electronics RMS House Vale Farm Road Woking Surrey GU11 DW Thame Systems
Thame Park Road
Thame
Oxon
OX9 3XD

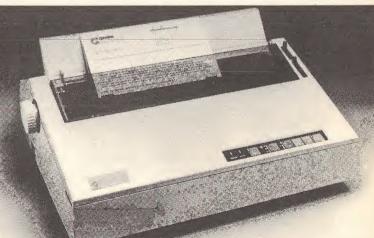
Amber Central Way Walworth Industrial Estate Andover Hampshire

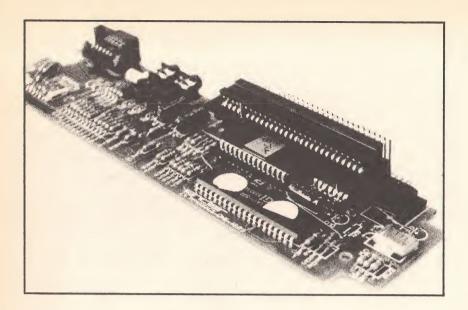
Norbain Micro Ltd. Norbain House Boulton Road Reading Berks RG2 0LT APT
2-4 Canfield Place
London
NW6 3BT

Intelligent Interfaces
18 Central Chambers
Wood Street
Stratford-on-Avon
Warks
CV37 6JD

CK Computers Ltd. 6 Devonia House High Street Weston-Super-Mare From left to right the pictures show Dean Electronic's Alphacom 32, Seikosha's GP 700-A Colour Printer, the MT180 from Mannesman Tally and one of Geveke's range of Printers.







#### **MICRODRIVE UPDATE**

#### THE HARDWARE

Last month our report on the microdrive detailed the additional commands supported by a Spectrum + Interface 1 + Microdrive combination and the form of the various commands concerned with loading and saving data with the Microdrive. This month we've had a chance to look at the hardware of the drive and have discovered a few things that might cause problems in the future.

With any review of a new product a degree of caution must be exercised. If a manufacturer supplies a reviewer with a preproduction version of a new piece of equipment, it would clearly be unfair to criticise the standard of construction if any shortcomings in this area would not be apparent on the production version.

In the case of the Microdrive however, to

the best of our knowledge, the drive and interface supplied to us were exactly the same as those being sent out to the lucky people at the top of Sinclair's waiting list.

The Microdrive itself looks to be a well constructed, sturdy unit that has been production engineered to a high standard. Thorn EMI should be able to churn out reliable drives at a fair old rate at an exfactory price that will leave plenty of change from the £50 asking price of the drive.

Interface 1 is however an entirely different proposition. Opening up the Interface reveals a board with a surprising amount of discrete circuitry. Much of this is assumed to be responsible for the RS232 interface and for the networking circuitry. To find such a number of resistors and transistors was however a surprise and we could not help but think that a DIL resistor package or two plus a transistor array would have reduced costs and added to the unit's reliability.

The other major surprise was the number of wire links and ICs with flying wires attached to their legs. Clearly there were a

number of mistakes in the tracking out of the PCB. In the main this sort of bodging is just about acceptable, in one case though, one end of a flying resistor was soldered to a track that was so thin that it was expecting rather a lot for it to stay in place if the interface were subjected to anything but the gentlest of handling. In fact after dropping our Interface, not deliberately we hasten to add, said resistor became detached and meant that the Drive failed to read anything from the data cassette.

In view of the fact that the PCB is clearly not in its final form the fact that the software is in EPROM rather than ROM is not so surprising.

It is difficult to see why, when Sinclair have taken over a year to provide the system, that when launched it should be as unfinished as it evidently is.

These 'bodges' also explain why the major factor limiting the production of microdrive systems is the rate at which Interface 1's can be produced - clearly manufacturing a board with so many flying leads must be a nightmare.

#### Connection Details

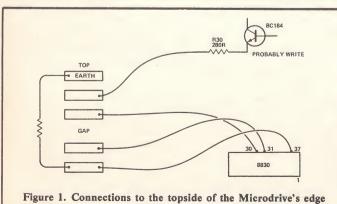
Our examination of the Microdrive lead to the two circuit diagrams shown, these are our best guess as to the location of the read and write lines to the drive. E&CM's tame hardware/software design engineer's to whom we lent our drive were of the opinion that it should not be too difficult to hook the drive up to other computers - Sinclair won't like it but thousands of Oric/Dragon/BBC owners would be clamouring for any unit that would allow the drive to be used with their computer.

#### Summing Up

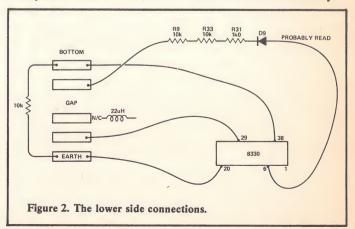
We cannot help but take our hats off to Sir Clive and his development team. The Microdrive for all its shortcomings, both in hardware design and in the patchy quality of the manual, represents a major breakthrough in low-cost mass storage systems.

We can only hope that the Microdrive is reliable in use for, with the likely level of sales, any company would be hard pushed to deal with the problems resulting from an unreliable product.

We think the drive is, if not the best thing since sliced bread, certainly yet another milestone in Sinclair's illustrious history.



connector.



#### SCOTLAND

BBC MIRCOCOMPUTER
FOR ALL YOUR REQUIREMENTS

from

CONNECTORS • PRINTERS

MONITOR ROM'S • COLOUR MONITORS

ALTERNATIVE D.F.S.'s

TORCH Z80 DISH PACKS with FREE Software

We have a full range on display.

Upgrading and Servicing work done.

47 KYLE STREET, AYR, KA7 1RS Telephone: 0292 - 285082

WEST COAST PERSONAL COMPUTERS

## NEW THE PICKARD JOYSTICK CONTROLLER

Use with any game. No special programme.

Any keys, not just cursors. Other add-ons not affected. ONLY £19.95 plus £1.50 p&p

Also in stock-

SPECTRUMS AND ZX81s
SOLIDISK RAM PACKS ...... from £19.00
DK TRONICS KEYBOARDS ...... £45.00
DK TRONICS SPECTRUM UPGRADE £30.00

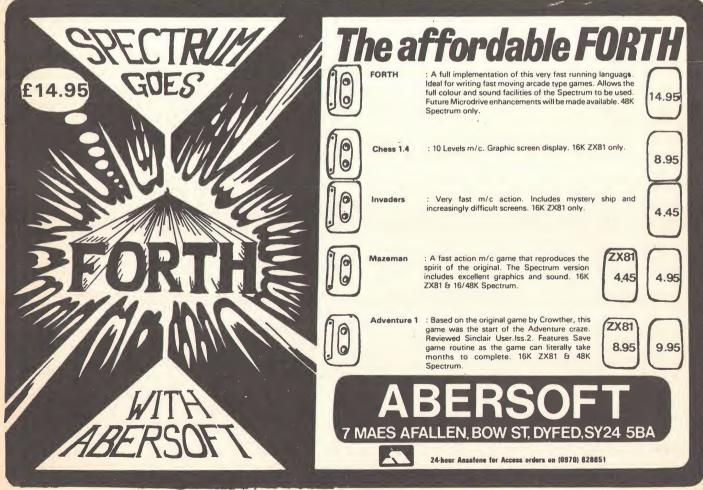
Business and Educational Software Now Available

BIG RANGE OF BOOKS 100s OF PROGRAMS GOOD AFTER SALES SERVICE

\* Access Orders 24Hrs Service

#### SUCCESS SERVICES

154 HIGH STREET, BLOXWICH, WALSALL Telephone: 0922 402403



#### **ORIC-1**

#### **USERS CLUB**

Join Now and receive:

- A Free 'Oric Toolbox' Cassette
- Monthly Members' Newsletter
- Details of our 'Star Tape of the Month'
- Our Mail Order Catalogue with the widest Oric range at 10% discount.

ANNUAL MEMBERSHIP £5.	00
6 MONTHS TRIAL £3.	00
OVERSEAS (1 YEAR) £8.	00
To join send fee, name, address and Tel. I	Vo.
or 50p for our Mail Order Catalogue only	,

Members deduct 10% from any item advertised and add p&p per item: 40p Software; £10 Hardware. Overseas add extra £1 per item.

#### LATEST ORIC RELEASES Available NOW

	Dinky Kong	£6.95	House of Death	£9.99
	Xenon 1	£8.50	Moria	£6.95
	Painter	£6.95	Grail	£6.95
-	Fantasy Quest	£6.50	M.S.T. Database	£19.95
	Hopper	£6.95	Oricade	£8.95
	Oric-Munch	£7.95	Oric Forth (+Man.)	£15.00
	The Swamp	£9.95	Wordprocessor	£15.00
	Invaders	£7.50	Oric Mon	£15.50
	Chess	£9.99	Reverse	£6.50

#### ORIC I USERS CLUB

31 North Street, Wareham, Dorset BH20 1AD Telephone: 09295 51383 with your Access, Barclaycard, American Express numbers for immediate despatch (24hr. Service)

#### ORIC PERIPHERALS NOW IN STOCK

MCP40 4 COLOUR PRINTER/PLOTTER

SHINWA CP80 PRINTER, F and T Feeds, True Descenders, Graphics, Centronics – ideal for Oric, Dragon, BBC, etc. . . . . . £322.00

Both Printers also ideal for Dragon, BBC, etc. P.A.S.E. JOYSTICK CONVERTER – Takes any digital Joysticks, including free games tape.

CENTRONICS PRINTER CABLE WITH CONNECTIONS £15.75

All Prices include VAT and FREE DELIVERY



### 80 Column Conversion for PET/CBM

Suitable for small screen PET with Basic 4.0

Plug in PCB, no track cutting Gives all the features of an 8032.

Also suitable for 'fat' forty.

for further details contact:



Delph Electronics Ltd.

4 Deeping Road, Baston, Peterborough. PE6 9NP. Tel: 077 86 535

#### **BBC MICRO CONSOLES**

Not just a monitor/tv stand but an expansion console which gives your micro the professional look. Protects and encloses your micro with room for disc drives and 2nd. processor or teletext adapter etc., all untidy connecting wires safely out of sight within the console. Made of light yet strong aluminium with a textured finish in matching BBC colour. Coming soon a bolt on extra module to the console for further expansion options. YES this console will grow with your needs. Basic BBC console as shown £39.99 + £4 carriage MAIL ORDER ONLY. Viewing by appointment only.

Please add 15% VAT.
For further information or send cheque to:



\* The console will house the Torch Disc Pack



Matching Printer Stand, can double for VDU Stand over the micro – only £14.99 + £2 carriage

27 WYCOMBE ROAD, LONDON N17 9XN. TEL: 01-801 3014 (24 Hr Ansaphone)

#### INDEX TO ADVERTISERS

3D COMPOTENS	IKON COMPOTER PRODUCTS
A & G HARDWARE 59	JCB (MICROSYSTEMS) 52
ABERSOFT 93	J L C DISPLAY ELECTRONICS 89
AGF HARDWARE 11	JP MAGNETICS
ARCADE COMPUTERS	LETHABY NUMBERING SYSTEMS
ASP EXHIBITIONS	LEVEL 9 COMPUTING40
BAMBY SOFTWARE	LONDON ELECTRONICS COLLEGE
BASICARE	MALISON ELECTRONICS
BROADWAY ELECTRONICS	MAPLIN
BUFFER	MIDWICH
BYTEWELL	
CAMBRIDGE COMPUTING 18	MICRO-MYTE 8
	MICRONETT 74-75
CHEETAH MARKETING 7	MICROPROCESSOR ENGINEERING LTD 45
CLWYD PERSONAL COMPUTERS	MINOR MIRACLES 85
COMPUSENSE 46	MULTIPLEX COMPUTER 60
COMPUTER ADD-ONS 41	ORIC SOFTWARE 55
COMPUTERS FOR ALL	PCW 60
CRICKLEWOOD ELECTRONICS	PETRON ELECTRONICS
D A COMPUTERS LTD 55	PH SCIENTIFIC PRODUCTS
DATA SERVICES 34	POWER INTERNATIONAL 85
DELPH ELECTRONICS	ROSCO LTD 89
DJL SOFTWARE 59	RPS ELECTRONICS
DOCTOR SOFT	SEVERN SOFTWARE
DRAGON DATA	SILENT COMPUTERS
ELECTRO AND GRAPHIC PRODUCTS	SINCLAIR RESEARCH
ENTERPRISE TECHNOLOGY	SORD
EPROM SERVICES	SPECTRE
FOX ELECTRONICS	STIRLING
GAMER	SUCCESS SERVICES 93
GAMES AND COMPUTERS	SUZO TRADING COMPANY
GILSOFT	
GLANMIRE ELECTRONICS	TASMAN
	TECHNOMATICS LTD
GREENBANK ELECTRONIC	TEVWARD MICROTECH
HARLEY SYSTEMS	VOLTMACE 40
HCCS ASSOCIATES 52	WATFORD ELECTRONICS 4-5
HCR ELECTRONIC SERVICES	WEST COAST PERSONAL COMPUTERS 93
ICS 59	

Classifieds contact NIK SAHA on 01-833 0531/2

Semi Display (min. 3 cm.)

1- 3 insertions £8.00 per sc cm the preceding month.

4- 9 insertions £7.50 per sc cm Lineage 25p per word min. 20

10-12 insertions £7.00 per sc cm words.

Copy Date by the third Monday of

#### **ASCII Keyboards**



- Upper & Lower Case plus Control
- Low Power Consumption
- Shift & Alpha Lock
- Model KB756A

56 key £4450 **KB710** Numeric Pad £ 7.50 **KB771** £57.50 72 key £65.00 **KB777** 77 kev

Accessories available include:-Metal Case

£15.95 Edge Connector £ 2.25 DC to DC Convertor (for operation off single 5V supply)

Autorepeat (Model 777)

■ Parallel Data Output

m Suitable for Tuscan,

Tangerine etc.

Metal Mounting Frame

#### **High Performance** Monitor



#### MONITOR

- ■12" Green P31 Phosphor
- MULLARD C.R.T. ■80 Character Line Capability
- 24MHz Video Bandwidth
- 240V AC Input
- Toroidal Transformer
- Composite Video Input
- Ideal for Apple, B.B.C. Micro, Gemini, Nascom,

Tuscan, Newbrain etc. MODEL 101

32K MEMORY EXTENSION

U.K. Orders add 15% VAT on order total. Overseas Orders add £6.50 to cover part cost postage and documentation, Delivery all items ex stock.

#### Citadel Products Ltd

#### **QUALITY** COMPUTER **TAPES**

Quality at realistic prices. 10xC10's at £5 p+p 50p. Full range in stock, send SAE for list.

We also offer a copying service to customers wishing to duplicate a cassette at £2.50 inc. tape p+p 50p. good discount on quantity offered to programmers.

Heath Microware, 4 Gateacre Ave., Oswestry, Shropshire (0691) 652626

#### ADD ONS

#### NO MORE EYESTRAIN WITH **YOUR ZX81**

Video inverter displays sharp white characters on solid black background TV screen. A toggle switch lets you choose between normal and reverse. The small PCB fits on top of the logic chip inside your ZX81. Kit £4, Built £5, includes easy to follow instructions, VAT/p&p. Send cheque/PO to: D. Frisch, 6 Stanton Road, Thelwall, Warrington, Cheshire, WA4 2HS.

FC07/10

#### SERVICES

#### **DUST COVERS**

Avoid damage to your computer or printer by using a Sherborne Dust Cover. Large stocks available for most makes or made to measure service.

Dragon, Atari Vic 20 - £2.95. BBC, TI, EPSON - £3.95. Spectrum - £1.95. Sharp MZ80 A/K - £4.95.



SHERBORNE DESIGNS Victory House, 8A The Bank, North Bradley, Trowbridge, Wilts. Tel: 02214 4425 Dealer Enquiries Welcome

VISA

EC07/10

#### PCB/ELECTRONIC ASSEMBLY

to sample or drawing. Short or continuous runs. Any quantity. 100% inspected. Special rates for small companies or large quantities. Fast turnaround and local deliveries if required.

#### **AUTRONICS LTD.**

23 Regency Gardens, Yardley Wood, Birmingham B14 4JS. Tel: 021-474 4638

#### **USER CLUBS**

#### PRINTERS

EPSON, OKI, SEIKOSHA, SMITH CORONA MANY OTHERS AVAILABLE We specialise in interfacing printers to SHARP MZ80K and SHARP MZ80A computers via our own design of interface card and can offer a special PRINTER PACKAGE PRICE. Many other ADD-ONS for SHARP including EPROM PROGRAMERS, ADC's etc. Details from Peterson Electronics Ltd. Academy Street, Forfar, Angus DD8 2HA

TEL: 0307 62591

COURSES

LEARN BASIC

Stay Friday to Sunday at one of Worcester-

shire's finest Hotels and learn "Basic" on

Commodore 64's. All rooms have bath, colour TV, etc. 14 hours of instruction from a

qualified lecturer. Cost £65 fully inclusive.

GAINSBOROUGH HOUSE HOTEL

Bewdley Hill, Kidderminster.

Tel: 0562 754041

Write for brochure to:

EC01/84ALT

FC09/10

#### JUPITER ACE USERS CLUB

probably your best independent reference point for getting more out of your machine".

(Personal Computer News)

THE best range of software. Add-on memory. ACE USER newsletter four times a year. Software to link the Ace to the cheaper printers (ZX,Tandy, Amber). How to add a full travel keyboard. Utility software includes Disassembler, Toolkit, Character Designer, Strings, Games in both 3K and 19K.

Subscription: £7 p.a. S.A.E. for details.

REMSOFT

18 George Street, Brighton BN2 1RH

#### FOR SALE

#### **ZX81 High Res Graphics Unit** £30 (inc. VAT, p&p)

Tel: William Haynes 01-969 0819 Tools for Living

Notting Dale Technology Centre 191 Freston Road, London W10 6TH

Cheque PO (add 15% VAT) plus 75p p&p

(EC08/11)

ACORN ATOM 14K RAM, 12K ROM, connectors, via, with getting aquainted and Atom magic books, asteroids. £125.00. Tel: High Wycombe (0494) 28202. (EC10).

Dept. ECM, 50 High Street, Edgware, Middlesex, HA8 7EP. Tel: 01-951 1848

SHARP MZ-80A/K. Renumber, append, converter, copier, wordpro, databank, games. Sensible prices. SAE for catalogue. DCS, 38 South Parade, Bramhall, Stockport (EC07/12).

#### **ACCESSORIES**

#### M & J SOFTWARE

Cassette based. Fully documented. Includes macro assembler.

FORTH ASSEMBLY LISTINGS ...... £7 each 6502, Z80, 6809, 8080, 6800, PDP-11, 68000, 1802

INSTALLATION MANUAL ...... £5 Complete guide to implementing FORTH from above listings.

6809 and 6502 MACRO ASSEMBLER ..... £5 Written in fig-FORTH. Structured one-pass assemblers. Provided in listing form or on cassette for Dragon or Microtan at £1 extra.

DRAGON COMPANION BOOK by Jarvis £4.95 ALL ABOUT FORTH by Haydon ...... £7.95

All prices inclusive.

Cheques and POs to:

M & J SOFTWARE

FC09

34 Grays Close, Scholar Green, Stoke-on-Trent ST7 3LU. Tel: 0782 517876

NASHUA 51/4" FLOPPIES hard or soft (10/16) sectored, boxes of 10, inc. VAT, SS/SD£19.15, SS/DD £20.40, DS/DD £23.00, SS/QD £30.00, DS/QD£31.90, p&p£0.50.8" Floppies, cartridges, disc packs also available. Cranswick Computers, Glecoe Cottage, Main Street, Cranswick, E. Yorks, YO25 9QN. Tel: (0377) 70683. (EC10).

#### FORTH **Available Now**

NAS-FORTH 1.11 For Nascom 2 etc.
Fig-FORTH with FORTH-79 additions. Complete with Z80 assembler and screen editor, Ram-Disc simulation, stack display utility, full support of Nas-sys routines. Extensive manual full system 9K on tape £25 + VAT.

PET FORTH 1.11 for 4000 and 8000 series. Fig-FORTH with FORTH-79 additions complete with 6502 assembler and screen editor. Ram-Disc simula-tion for tape version. Stack display utility. Powerful IEEE control words. Extensive manual. Tape version £25 + VAT. Disc version including tutorial disc £75 + VAT.

xEORTH for CPM systems

FORTH-79 for all Z80 CPM systems. Extensive manual. All above features and more £75 + VAT including

Purchase of our products includes free membership of xFORTH Users Group, and FORTH tutorial disc or tape. Purchase price includes multiple copies. Full range of FORTH books available.

Coming soon: FORTH-I/O Cartridge for the Spectrum Write or telephone for more details: 0202 764724. David Husband, 2 Gorleston Rd., Branksome, Poole, Dorset BH12 NW.

#### ZX-SPECTRUM SOFTWARE

We are offering a 10% discount on our stock of 17 cassettes if either 2 or more cassettes are purchased or a minimum order of £10 is made.

Telephone 031-334-7261 for details of our send a SAE to:

**RULE COMPUTERS** 30 Tylers Acre Road, Corstorphine, Edinburgh EH12 7HZ.

FC09/10

#### SHORT-LENGTH **COMPUTER/AUDIO TAPES**

Premium Grade Agfa R.F.W. Cassettes Manufacturers of high quality blank cassettes suitable for programming. For example, with a minimum order of 25, you can purchase 25 cassettes of 2½ minutes each of £1.95p. Fill in the coupon and post with your remittance to: R.F.W. Recording Supplies, Green Acres, Northlands, Sibsey Nr. Boston, Lincolnshire PE22 OUA. Tel: 0205 750 595

All prices are inclusive of VAT at 15%

Please send me high-quality audio tapes in the quantity indicated (tick where applic-

25 cassettes (including £1.95 p&p)

□ 2½mins.....£11.95 5 mins ...... £12.20 □ 6 mins ......£12.45 □ 7½ mins..... □ 10 mins £13.20 □ 12½ mins £13.95

50 cassettes (including £2.49 p&p)

□ 2½ mins....£22.75 £23.49 □ 7½ mins ......£23.99 10 mins ..... 

100 cassettes (including £3.50 p&p)

□ 2½ mins.....£43.50 □ 6 mins ......£45.50 7½ mins.....£46.50 □ 10 mins £48.50 □ 12½ mins £53.5€ Including inlay card & side-labels. Total Remittance £\_

NAME

ADDRESS\_

I enclose my cheque/PO\_

Please make cheque/PO payable R.F.W.

EC09/10

INPUT/OUTPUT SPECTRUM PORT. Assembled, tested, complete with edge connector and I/O sockets, 8 bits in 8 bits out. Instructions supplied. Send only £14.95 or SAE for details. Aldeco, 77 Cants Lane, Burgess Hill, Sussex, RH15 OLX. (EC10/11).

#### SPECTRUM OFFERS

1. Spectsound THE Music Program. Complete with keyboard Overlays. Beep Chart and full instructions. Offer Price £4.95.

"excellent value" — Sinclair User.

"comprehensive and easy to follow" — H.C.W.

2. Spectrum Dustcovers — A must if you leave it out! Unique design allows leads and most interfaces to remain connected.

Offer Price £1.75 — Smart tough Blue PVC. The Best around! All prices include P&P.

PDQ Software, Dept. EC, Parsley Rye, Hilders Lane, Edenbridge, Kent, TN8 6JU.

A.C.LINEAR CIRCUIT Analysis Programmes for Sinclair Spectrum (48 K), BBC Model B and Grundy New-Brain Microcomputers. Analyses circuits with up to 16 nodes and 60 components. Very easy to use. Cassette £35. To order - send cheque or telephone your name, address and Access or Visa number. Number One Systems, 9A Crown Street, St. Ives, Huntingdon, Cambs. Tel: St. Ives (0480) 61778 (24hr. answering). (EC08/09).

#### HARDWARE



price. Gives your computer an unlimited vocabulary (nothing more to buy!). Self contained speaker/ amplifier, Sinclair connector etc, PLUS Expansion socket for BIG EARS AND Monitor socket for Music Board. Full instructions, technical notes and programme examples supplied with this outstanding educational unit.

OR COMPLETE D.I.Y KIT £39 DEALER ENQUIRIES WELCOME

As seen on BBC TV "Computer Programme" \*BIG EARS \* 10,00, pt

SPEECH INPUT FOR ANY COMPUTER



Hugely successful Speech Recognition System. complete with microphone, software and full instructions. complete with microphone, software BUILT TESTED & GUARANTEED PLEASE STATE COMPUTER: UK101, SPECTRUM, ATOM, NASCOM2, Vic 20, Micron, ZX80/81, PET, TRS80, MZ80K, APPLE II, BBC MICRO NEW: FAST MACHINE CODE FOR ZX SPECTRUM

ZX81/SPECTRUM

MUSIC SYNTHESISER (STEREO) + 16 LINE CONTROL PORT

Pray 3-part musics, counce seatcs, decay and frequency. Input/Output lines provide control and monitor facility for Home Security, Robot Control, Model Railway etc. etc. Works with or without 16K RAM.

Add keyboard to make a live performance polyphonic synthesiser! Full instructions/software included.

AMAZING VALUE AT ONLY £19.50 (KIT) Extra 23 way connectors at £2.60

£25.50 (BUILT)

THE COMPOSER

Music Programme for above synthesiser. Enter and play 3 part harmony. Includes demonstration tunes.

Recommended £7.40

COLOUR MODULATOR RGB in, PAL/UHF out (not for ZX)

KIT £15 BUILT £20

SPECIAL OFFER SPEECH OUTPUT CHIP SX-01 Phoneme Speech Processor

I.C. £18

Please add VAT at 15% to all prices. Barclay/Access orders accepted by telephone

DATA £0.60 All enquiries S.A.E. please

WILLIAM STUART SYSTEMS Ltd

Quarley Down House, Cholderton, Nr. Salisbury, Wilts SP4 0DZ. Tel: (098064) 235 Also: 01-221-1131

VISA

#### DRAGON 32 - HARDWARE

New Plug-ins for your DRAGON 32 ADC-09 Analog to Digital Converter £29.50 DR8CHR Relay output box from £16.75 D232 RS232C Interface £35.00

Coming soon . . . An EPROM Programmer please enquire.

Postage and Packing 50p per Order. Large S.A.S.E. for full catalog to:-

**PNP Communications** 

62 Lawes Avenue, Newhaven, East Sussex BN9 9SB. Tel: (0273) 514465

MULTICORE SOLDER at trade prices. Also BIP computer care products again at trade. Enclose SAE for full price list to Aycliffe Electronic Supplies, 18 Hambleton Court, Newton Aycliffe, Durham DL5 7 HR. (EC07/10).

#### SOFTWARE

TO DRIVE?

LEARNING LEARNER DRIVER DRIVERWHO **16K Spectrum** (FREE Highway Code)

**KNOWS IT** ALL?

Two fascinating educational/fun programs from a professional driving school on one tape.

#### **PASS YOUR TEST**

Driving Test Simulation. Are you good enough to pass first time?

#### **KNOW YOUR SIGNS**

Test your knowledge of the Highway Code

Both 16K programs on tape. Unique and excellent value at an inclusive price of £6.00

Cheques to:

M. J. Hawkins, D.O.T.A.D.I., M.I.A.M. Stowe IX Churches School Of Motoring (Est. 1974)

Benu Vista, Church Stowe, Northampton

#### **BCPL FOR THE BBC**

The most powerful language for the BBC Microcomputer, includes a full screen editor and assembler.

Language ROM, 450 page Manual, Utility disk.

Published by Acornsoft . . . £99.65

also BCPL for any CP/M . . . £172.50

P&P ..... £2.00

#### Richard Computer Products Ltd.

Brookside, Blewbury, Didcot, Oxon. OX11 9QA. Tel: (0235)850218

TV TO SCOPE CONVERTER. External unit plugs into aerial socket & converts TV into large screen oscilloscope. Circuit & Plans £3 (or SAE details). J. Bobker, 29 Chadderton Drive, Unsworthy, Bury, Lancs. (EC09).

BBC MICRO RTTY PROGRAM. Split screen, type ahead. Cassette and instructions £7.50. Disk £9.50. P. J. Harris (G3WHO), 10 Appleby Close, Great Alne, Alcester, Warwickshire. Telephone (078981) 377. (EC10/11).

#### SECURITY

FREE COMPREHENSIVE CATALOGUE

- LOWEST DISCOUNT PRICES
- HIGHEST QUALITY EQUIPMENT FREE DIY DESIGN GUIDE
- FULLY ILLUSTRATED
- MICROCHIP CIRCUITRY
- QUICK DESPATCH SERVICE
- FULL INSTRUCTIONS SEND SAE OR PHONE

C-TEC SECURITY, Dept. EC, 60 Market St, Wigan WN1 1HX. Telephone (0942) 4<u>2444</u>

Trade Enquiries Welcome

#### **MISCELLANEOUS**

**ENTREPRENEUR INTERNATIONAL: world's** most exciting self-employment publication and vital key to your success in your own profitable business. Free introductory offer. Also sales agents wanted. S.a.e. for details: Entrepreneur International, Dept. M36, Alston, Cumbria CA9 3RP. (EC10/3).

#### ELIECTRONICS & COMPUTING MONTHLY Farringdon Road, London EC1R 3AD. 01-833-0531

Noins sersions	
BoiNo. Required Yes/No	Please insert the following advertisement in Electronics & Computing Monthly

Please Tick	Month	J	F	М	Α	М	J
if Series		J	Α	S	0	Ν	D

Method of Payment Cheques should be made payable to Electronics & Computing Monthly I enclose herewith Cheque/PO or Int. Money Order for

Please debit my Access/Visa Barclaycard as below



BARCLAYCARD VISA

SIC	∋NA	TURI				


NAME (Please include initials)		
ADDRESS		
Daytime Telephone No		· · · · · · · · · · · · · · · · · · ·
Payment be credit card please st	ate address card is regi	stered.

#### DON'T FORGET . . .

Copies of bound reprints describing the E&CM hi-res computer's CPU board, cassette I/O, memory board and graphic card are still available from our offices at an all inclusive price of £2.95.

#### \*\*\*\*\*\*\*\* **ASTROLOG**

truly AVAILABLE AT YOUR FINGERTIPS

USER PROMPTING PROGRAMS: merely key in birth information as requested by the computer — READ OUT (and/or PRINT OUT) what is normally the result of many hours of painstakingly tedious and complex mathematical calculations using tables, ephemera, etc.

THE SIDEREAL TIME OF BIRTH.

THE ASCENDANT AND MIDHEAVEN in Sign, Degrees, Minutes

and Seconds for EQUAL HOUSE SYSTEM.

THE SIGNS AND POSITIONS OF THE HOUSE CUSPS in Sign,
Degrees, and Minutes for the PLACIDEAN SYSTEM.

THE SUN AND MOON POSITIONS in Sign, Degrees, Minutes and Seconds.

ALL THE PLANETS' POSITIONS in Sign, Degrees and Minutes. THE LUNAR NODE — THE PART OF FORTUNE — THE VERTEX AND A HOST OF OTHER BIRTHCHART INFORMA-TION AT THE TOUCH OF A KEY.

#### **ZX81 16K**

ZODIAC I

ONLY £10.00

ZODIAC II

ONLY £8.00

GIVES YOU THE ASPECTS AND MIDPOINTS

#### FOR 48K SPECTRUM AND DRAGON 32

ZODIAC F

Full combined program on one cassette

FOR ONLY £15.00

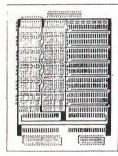
Other programs in course of preparation include: PRO-GRESSING THE HOROSCOPE; RECTIFICATION OF THE BIRTH TIME, etc.

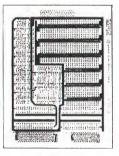
Send orders with cheque payable to:

#### STELLAR SERVICES

**8 FIR TREE VALE, LEEDS LS17 7EY** Tel: (0532) 692770

#### **MICRO-COMPUTER DEVELOPMENT BOARDS**





#### MCDB-A

MCDB-B

#### Each Board Features:

- High quality double sided p.c.b. layout
- Solder resist finish
- Spaces for TTL/CMOS logic
- Spaces for microprocessor and peripheral devices
- Ready laid out interconnections for memory chips assembly
- One D type and two ID connector spaces
- Board dimensions are 20cm x 15cm

#### 100% through plated holes

#### In Addition:

MCDB-A accepts up to twelve 24-pin SRAM/ROM/EPROM chips with only 3 control pins unconnected

MCDB-B accepts eight 16K, 64K or 256K dynamic RAM chips and two 28/24-pin ROM/EPROM chips.

Price £14.95 inclusive.

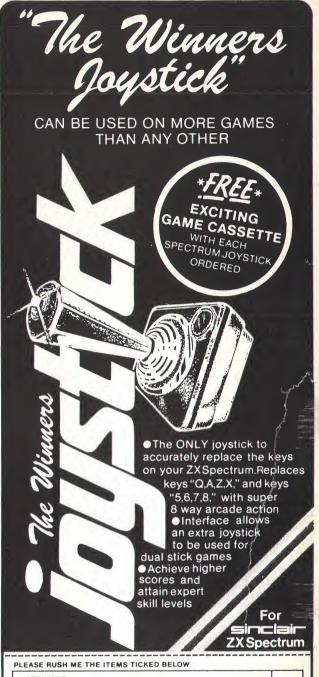
ECM09

Available from:

WYMER ELECTRONICS 8 Briar Place, Dunfermline, Fife KY11 4BE Telephone: 0383 418101



Enquiries from retailers and educational establishments welcome



PLEASE RUSH ME THE ITEMS TICKED BELOW		
HARDWARE		
1) TE 122 SPECTRUM JOYSTICK	£24.95 £7.95	
TE 123 EXTRA ADD ON JOYSTICK	17.95	
11 TE 200 CASSETTE FORTH	£10.95	
GAMES SOFTWARE TE 201 SPECMAN 16K	£4 95	
TE 202 BLITZ 16K TE 203 BREAKOUT 16K	£4 95 £4 95	
TE 204 SNAKE BYTE 16K	£4 95	
TE 205 BACKGAMMON 48K PLEASE SEND ME DETAILS OF ZX81 & SPECT	£7 95 FRUM ADD-ONS	
HARDWARE ADD 80p POST & PACKING	POST & PACKING	
SOFTWARE POST FREE ALL PRICES INCLUDE VAIT	TOTAL	
CHEQUES POSTAL ORDERS MADE PAYABLE TO THU TO PAY BY CREDIT CARD PLEASE GIVE YOUR NUMBER		IICS
ACCESS/BARCLAYCARD NO.		

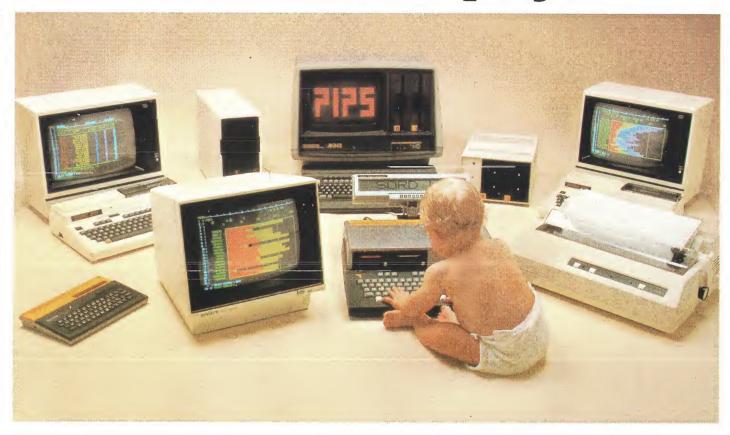
SIGNATURE ECM<sub>10</sub> ADDRESS

Please Post To: THURNALL ELECTRONICS, 95 LIVERPOOL RD. CADISHEAD, MANCHESTER M30 5BG





## Business Management is now child's play...



#### ...thanks to PIPS!

- PIPS is the simple microcomputer language of today. With PIPS you can learn to handle business accounting systems in a single day.
- PIPS has been designed for use with SORD's complete range of microcomputers.
   PIPS makes conventional programming obsolete.
  - SORD, the fastest growing company in Japan, is one of the world's largest manufacturers of microcomputers.
    - SORD offers the complete product range, from game computers to sophisticated business systems.
- Test our claim: bring your business data to our weekly PIPS Seminar and we will help you
  process it in a single day completely free of charge. Ring us now on 01-930 4214 or
  contact your nearest SORD dealer.

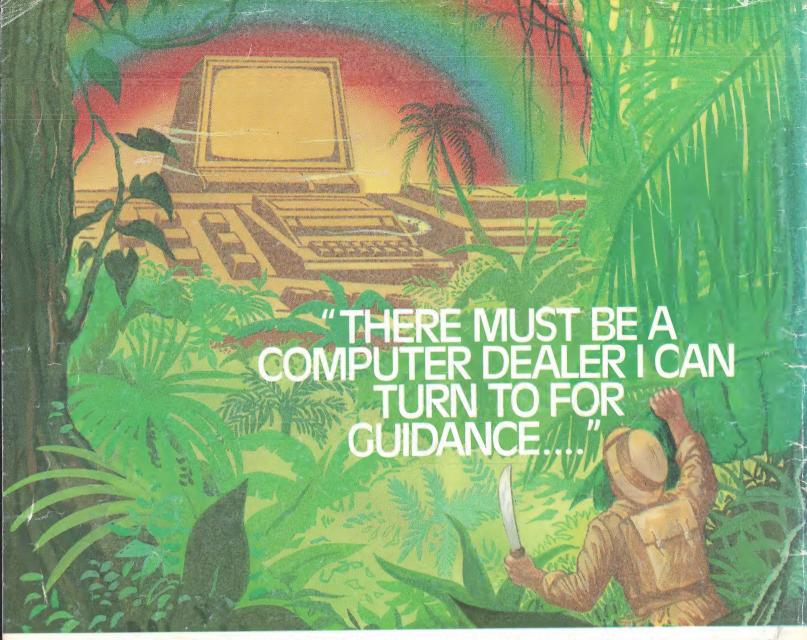


TOKYO AND NOW LONDON

Socius Computer Systems (UK) Ltd., Samuel House, 6 St. Albans Street, Haymarket, London SW1. Tel: 01-930 4214

London & South East Clear-View Rental & Relay Ltd., East Sussex. Tel: (0323) 898989 Integrated Business Micro Systems Ltd., W1. Tel: 01-878 9847 - J. R. Instruments, Surrey.
Tel: 01-657 1700 - Microstream, EC1. Tel: 01-251 5377 - Newman Business Machines &
Supplies Ltd., East Sussex. Tel: (08296) 64155 - Opus Systems, Staines. Tel: (0784) 57265 Spand Commercial Services Ltd., Hythe, Kent. Tel: (0303) 65351 - South & West Apollo
Administration Bureau Ltd., Penzance. Tel: (0736) 66336 - Micro Xzec Ltd., Bounnemouth.
Tel: (0202) 21220 - C. M. Computer Systems Ltd., Chippenham. Tel: (0249) 651341 - Micro
Experience, Gloucester. Tel: (0452) 500010 - Z. R. International Ltd., Bath. Tel: (0225) 64001 Midlayda Executive Data Systems Ltd., Nottingham. Tel: (0602) 413494 - Largotim Ltd.,
West Midlands. Tel: (0384) 232596 - R.-Mark Systems, Abingdon. Tel: (0235) 28179 North A. Genrard (Micros) Ltd., Ormskirk. Tel: (0695) 42239 - E6B Systems, Cheshire.
Tel: (06065) 53722 - Grove Computing Services, Manchester. Tel: (061) 231 4727 - Scotland
Admin Systems, Strathchyde. Tel: (0436) 71189.

SORD, Samuel House, 6 St. Albai Please send further information a	ns Street, Haymark and my invitation to	et, London SW1. Tel: 01 o a FREE 1 day PIPS se	1-930 4214 minar.
Name			
Position			
Company			
Address			
	Tel	Ext	ECM2



If you're still staggering through the computer jungle and not getting sensible answers to your questions, we have some good news:

Now you can turn to **professional** people who are capable of giving you sound advice on practically all aspects of popular computing.

They all have one thing in common: They are **COMPUTERS FOR ALL** dealers.

A Computers for All dealer is different from the normal Computer retailer.

Not surprisingly he won't try to sell you things like cameras or cosmetics; stationery or sealing wax.

He will, however, be capable of answering sensibly almost any question you have on computers and computing, and have readily available a wide range of popular computers, hardware, software, books, and perioderals.

So why not call in at your local **COMPUTERS FOR ALL** dealer today? He can lead you in the direction you want to travel.

#### The shops where people matter:

AVON
JADE COMPUTERS
Coombend, Radstock, Bath.
0761 32570.
MERCATOR COMPUTER
SYSTEMS
3 Whiteladies Road, Clifton,
Bristol. 0272 731079.
MOBILE MICROS
2 Castle Street, Thombury,
Bristol. 0454 418383.
BERKSHIRE
KENNETH WARD COMPUTERS
Verve House, London Road,
Sunningdale. 0990 25025.
CHANNEL ISLANDS
MEGA LTD.
7 Anley Street, St. Helier,
Jersey, 0534 72263.

Sunningdale. 0990 25025.
CHANNEL ISLANDS
MEGA LTD.
7 Anley Street, St. Helier,
Jersey. 0534 72263.
CHESHIRE
THE COMPUTER CENTRE
68 Chestergate, Macclesfield.
CORNWALL
COMPUTAVISION
4 Market Street, St. Austell.
0726 5900.
FAL-SOFT COMPUTERS
85 LG George's Arcade;
Fallmouth TR11 3DH. 0326
314663.

DEVON
A & D COMPUTERS
"Computerland", 6 City
Arcade, Fore Street, Exeter.
0392 77117.
BITS & BYTES
44 Fore Street, lifracombe, N.
Devon EX34 9J.D. 0271 62801.
COMPUTER SYSTEMS
(TORBAY)
Pump Street, Brixham.
080456565/6.
CRYSTAL COMPUTERS
CRYSTAL COMPUTERS

209 Union Street, Torquay. 0803 22699. SYNTAXLTD Midhurst, Grenofen, Tavistock. 0822 2392.

DORSET
DENSHAM COMPUTERS
329 Ashley Road, Parkstone,
Poole.

ESSEX AKHTER INSTRUMENTS Unit 19, Arlinghyde Estates, South Road, Harlow. 0279 412639. COMPUTERS FOR ALL 72 North Street, Romford. 0708 752862.

HANTS
MICRO VIDEO STUDIOS LTD.17 Turks Street, Alton. 0420
82055.

HERTS
VIDEO CITY
45-47 Fishers Green Road,
Stevenage. 0438 53808.
THE COMBINED TRADING CO.
10 & 11 Salisbury Square,
Old Hatfield.
07072 65551.
THE ROYSTON MICROCENTRE
1.John Street, Royston.
0763 42622.

KENT APHROS SOFTWARE CO. 47 Hawkey Square, Margate, Kent. 0843 294699. MEDWAY COMPUTERS 141 New Road, Chatham. 0634 826080.

MICRO MAGIC 128 Erith Road, Bexleyheath. 0322 523052. THE DATA STORE 43 Shepperton Road, Petts Wood. 0689 26698. THE MICRO SHOP 11 The Pantiles, Tunbridge Wells. 0892 27991

LANCS
P.C.S.
39 Railway Road, Darwen. 0254
776677.
4 MAT COMPUTING
67 Friargate, Preston.
THE HOME COMPUTER CENTRE
40 King Street, Blackburn.
0254 671316.

LEICS
DMERSION
27-29 High Street, Leicester.
053357479.
LONDON
KAYDE HOME COMPUTERS
1 Station Approach, New Eitham,
London SE9 01-889 7505.
KELLY'S COMPUTERMARKET
227 Dartmouth Road,
Sydenham, London SE26 4QY.
01-699 4399/6202.
MIDDLESEX
SCREENS MICROCOMPUTERS

SCREENS MICROCOMPUTER 6Main Avenue, Moor Park, Northwood, 09274 20664. TWILLSTAR COMPUTERS 17 Regina Road, Southall. 01-574 5271. N. IRELAND

N. IRELAND
D. V. MARTINLTD.
13 Bridge Street, Belfast,
BT1 11.T. 0232 226434.
MCLAUGHLIN ELECTRONICS
44 Carlisie Road, Londonderry.
0504 65002.
NORTHAMPTONSHIRE

NOR I HAMP I UNSHIRI LEISURETIME 13 The Friary, Grosvenor Centre, Northampton. 0604 36726.

OXFORDSHIRE SCIENCE STUDIO 7 Little Clarendon, Oxford OX1 2HP. 0865 54022. SHETLANDS TOMORROW'S WORLD Esplanade, Lerwick, ZE1 OLL. 0595 2145.

SUFFOLK BECCLES COMPUTERS 5 The Ridings, Worlingham, Beccles. 0502 715061. SURREY ANIROG COMPUTERS

8 High Street, Horley. 02934 2007. COMPUTASOLVE 8 Central Parade, St. Marks Hill, Surbiton. 01-390 5135.

SUSSEX THE COMPUTER CENTRE (BMS) LTD. 37d & 37e Robertson Street, Hastings, East Sussex. 0424 439190.

439190.
S. WALES
AUTOMATION SERVICES
(S. WALES)
3 Wermeys Road, Penysfai,
Bridgend. 0656 720959.

DAN EVANS (BARRY) LTD. 81 Holton Road, Barry, South Glamorgan. 0446 734242. MORRISTON COMPUTER CENTRE

37 Clase Road, Morriston, Swansea SA68DS.0792 797572. STEVE'S COMPUTER CO. LTD. Castle Arrage, Cardiff, South

STEVE'S COMPUTER CO. LTI Castle Arcade, Cardiff, South Glamorgan. 02224 1905. TYNE & WEAR THE COMPUSHOP 10 Newgate Centre, Newcastleupon-Tyne NE1 5RE. 0632 618673.

WARWICKSHIRE
IMPULSE MICRO SYSTEMS
LTD.

6 Central Chambers, Cooks Alley, Wood Street, Stratford-Upon-Avon. 0789 295819. WEST MIDLANDS
CALISTO COMPUTERS LTD.
119 John Bright Street,
Birmingham B11BE. 021-632
6458.

JBC 200 Earlsdon Ave. North, Earlsdon, Coventry. 0203 73813.

WORCESTERSHIRE
DEATHVALLEY COMPUTERS
P.O. Box 54, Worcester WH2
6QA. 0905 640400.
EVESHAM COMPUTER CENTRE
Crown Court Yard, Bridge St.,
Evesham. 0386 48635.

YORKSHIRE COM-TEC 6 Eastgate, Barnsley, South Yorkshire. 0226 46972.

